ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Vol. XXXI, No. 21.

TABLE OF CONTENTS.

ENGINEERING NEWS OF THE WEEK.....421, 436
Stand-Pipe Accidents and Failures (continued)... 422
Falls-of-Schuylkill Bridge; Philadelphia & Reading R. R. (illustrated)..... 423
Corrosion of Pipes by Electric Currents..... 424
The Niagara Falls Power Plant (illustrated).... 426
Legal decisions..... 428
A Combined Gas and Electric Light Plant at Circleville, O..... 433
Failure of a High Building by Wind Pressure, New York city (illustrated)..... 434
A New Logarithmic Cross-Section Paper..... 434
The Chenab Weir (illustrated)..... 435
Weather Report for April..... 436
PERSONALS, NEW PUBLICATIONS, SOCIETY PROCEEDINGS 429
EDITORIAL NOTES 430
Formula for Calculating Cross-Sections—An Asphalt Pavement that Won't Wash—Proposed Extension of Brooklyn's Water Supply—Prevention of Water Waste by the Use of Meters.
EDITORIALS:
Cast Iron Columns for High Buildings..... 430
Rapid Transit Prospects in New York, Boston and Philadelphia 431
LETTERS TO THE EDITOR..... 431
Hydraulic Formula for Water Power Computation—An Error in Baker's Masonry Construction—Specifications for Stand-Pipe Steel—Leaning Stand-Pipe at Holdrege, Neb.—Stand-Pipe Accident at Bayshore, L. I. (illustrated)—Litigation over Car-Heating Patents—Adjusting Compass Zeros on Transits—Molds for Pouring Lead Joints—Details for Cast Iron Columns (illustrated)—The Electro-Pneumatic and Manual Interlocking Systems Compared.
CONSTRUCTION NEWS..... 436
Railways, Street and Electric Railways, Elevated Railways, Highways, Bridges and Tunnels, Water-Works, Artesian Wells, Irrigation, Sewers, Streets, Electric Light and Power, Miscellaneous Contracts and Supplies, Condensed List of Contracts Pending with Date of Opening Bids, Contract Prices, Metal Market Prices.
INDUSTRIAL NOTES..... 440

The Chamber of Commerce Rapid Transit bill, recently passed by the New York state legislature, has been signed by the governor. This bill gives the city of New York the option of municipal construction and ownership of the rapid transit system, subject to a vote of the electors of the city at a general election, and names as the first board of Rapid Transit Commissioners: The Mayor and Comptroller or other chief fiscal officers in New York city, and the president of the Chamber of Commerce ex-officio, and William Steinway, Seth Low, John Claflin, Alexander E. Orr, and John H. Starin.

A 25,000,000-gallon increase to the daily capacity of the Brooklyn water supply system is recommended in a report by Mr. Robt. Van Buren, M. Am. Soc. C. E., late Chief Engineer of the Brooklyn city works department. Additional water would be secured by taking in a drainage area on Long Island to the east of that now tapped and would involve a gravity conduit, a new pumping station and force mains, all at an estimated cost of some $2,000,000, of which $700,000 is for the extension into new territory.

The average total precipitation at 83 rainfall stations in New York state in 1893, as given by the State Weather Bureau report for December, was 42.34 ins. The maximum observed precipitation for the year was 71.05 ins. and occurred at Eden Center, Erie Co., in the western part of the state, near Lake Erie. The minimum precipitation reported was 24.59 ins., at Fleming, Cayuga Co., somewhat west of the center of the state. The greatest local monthly precipitation was reported from Easton, Washington Co., for August, and was 12.48 ins., while the least was 0.53 in., at Stillwater, Saratoga Co., in November. The report contains detailed statistics of rainfall and temperature throughout the state for the month of December and for the year, and also charts showing for the month of December and for the year the average rainfall, temperature and cloudiness throughout the state, and also diagrams showing for each day in the year the average daily temperature and rainfall over the state and the atmospheric pressures, reduced to sea level, recorded at Ithaca for each day of 1893. Prof. E. A. Fuertes, of Cornell University, Ithaca, is director, and W. O. Kerr is secretary of the State Weather Bureau.

Rapid progress has recently been made on the tunnel of the East River Gas Co., now nearing completion, and on May 19 only 500 ft. remained to be driven. The tunnel is to extend from the foot of East 70th St., New York city, to Astoria, underneath the East River, and was fully described and illustrated in our issue of March 1, 1894. The following information regarding the progress of the work was given us by Mr. Charles M. Jacobs, of 192 Broadway, the chief engineer of the work:

Since passing through the soft ground, described in Engineering News of March 1, a very hard hornblendic gneiss has been encountered on the New York end and a varying formation of white spar and hornblendic schist on the Long Island side. In the two headings the recent total progress has been 591 ft. in 98 working shifts of 12 hours, giving an average drive per shift of over 6 ft. The fastest driving has been done on the Long Island end, where as much as 94½ ft. has been driven in one week and on the New York end where 82½ ft. has been executed in the same time. The minimum cross-section of heading in rock is 10 ft. wide by 8½ ft. deep, but for the greater part of the distance this width is considerably exceeded. To obtain the fastest work the high grades of dynamite have been found most advantageous, the best recent results being obtained from 75% powder. Considering the character of the rock and the fact that the tunnel is being driven underneath a great body of water, this rate of progress is among the highest records ever made.

The contracts for sections N and O of the Chicago drainage canal, bids for which were received April 18 (Eng. News, April 25, May 3), have been let to Hayes Bros., Chicago, Ill., and the McMahon & Montgomery Co., Chicago, Ill., respectively. The bid for section N made by Hayes Bros., was 23 cts. per cu. yd. For section O McMahon & Montgomery accepted the contract at the prices bid by the Green Dredging Co. and have associated that company with them in the work. These bids were 19.9 cts. per cu. yd. for the material removed and 24 cts. per yd, for that used for grading and other purposes on the section. According to the engineer's estimates of the respective quantities to be removed and used on the section, these figures give substantially a price of 21 cts. per cu. yd. for the whole work. Associated with the two principal contractors are the Fitz-Simons & Connel Co., and the Chicago Dredging & Dock Co., in addition to the Green Dredging Co. before noted. The several contractors will work in conjunction on the two sections and each has signed both contracts.

The most serious railway accident of the week was a rear collision May 19 in the Standing Rock tunnel on the Newport News and Mississippi Valley Ry., twelve miles from Princeton, Ky. A construction train was backing through the tunnel to take the sidetrack at the east end, when it was run into by a westbound extra freight train. The boarding car of the construction train was smashed to pieces by the freight engine and six men in it were killed, while the tunnel was blocked by the wreck of a dozen box and flat cars. A flagman had been sent back by the conductor of the construction train, but while the conductor claims that the man had ample time to go back far enough to flag the freight train, the flagman claims that the construction train followed him before he had time to get out of the tunnel.

Heavy rainstorms and floods have occurred in Pennsylvania and in the northwest, and an immense amount of damage has been done to property. Several mill dams in Minnesota and Wisconsin have been washed out, and also the large dam at Lima, Mont. Railway washouts have been numerous and many bridges have been carried away, as noted in our bridge news in another column. In Pennsylvania the greatest damage was along the valley of the Susquehanna and railway traffic was seriously obstructed.

The latest oil field reported is in southeastern Kansas. A well drilled at Neodesha, Wilson county, to a depth of 850 ft. is reported to have sent a stream of oil above the top of a 74-ft. derrick when the vein was struck.

The triple-screw cruiser "Columbia" has been given a sea trial of 48 hours and developed a speed of 18½ knots with natural draft and the three engines at work. Runs were made with the two side screws only and with the center screw only. At 10 knots the vessel's daily coal consumption was found to be about 35 tons, and at 14 knots about 70 tons.

The torpedo boat "Ericsson" was launched at Dubuque, Ia., May 12. It is built of steel, and is 150 ft. long, 15.62 ft. beam, 4.75 normal draft amidships, 10 ft. 6 ins. in depth, and 120 tons normal displacement. The hull is strengthened by 15 bulkheads, which divide it into water-tight compartments. There are two sets of four-cylinder quadruple expansion engines of the vertical, inverted, direct-acting type, operating twin screws, and making 420 revolutions per minute. The engines are rated at 1,800 HP., but are expected to develop 2,000 HP. The boilers are of the Thornycroft pattern, and there is bunker capacity for 40 tons of coal. There is a torpedo tube at the bow, and also two training tubes, with four one-pounder rapid fire guns.

The recent earthquakes in Greece and Venezuela have been unusually severe, and the discussion of them has led to the publication of the following table of great earthquakes and approximate loss of life:

Year. Place.	No. of lives lost.
1158—Syria	20,000
1268—Cilicia	60,000
1456—Naples	40,000
1531—Lisbon	30,000
1626—Naples	70,000
1667—Schamaki	80,000
1693—Sicily, Catania, etc.	100,000
1703—Jeddo, Japan	200,000
1706—Abruzzi	15,000
1716—Algiers	20,000
1731—China	100,000
1746—Lima and Callao	18,000
1755—Lisbon	50,000
1759—Baalbec, etc	20,000
1797—Panama, etc.	40,000
1822—Aleppo	20,000
1851—Milo, Italy	14,000
1857—Calabria, etc.	10,000
1867—Peru and Ecuador	25,000
1875—Colombia	14,000
1883—Krakatoa	100,000

Cableways 400 to 900 ft. long are used for loading lumber into vessels at places along the Pacific coast in California and Oregon, where the sawmills are on the high rocky cliffs. The sea ends of the cables are attached to buoys when not in use. A ship preparing to take a cargo takes the cable from the buoy and attaches it to a mast or to a derrick frame over the hatchway. The carriers with lumber are run in and out along the cable by means of hauling ropes.

A downtown belt line for the business district of Chicago, to be constructed and maintained at the joint expense of the various elevated railway companies, is now being talked of. The line will run on Wabash Ave., Lake St., Fifth Ave. and either Jackson or Van Buren Sts. The Lake St. Elevated will enter the loop at Lake St. and Fifth Ave., where there will be a union station. It will then turn south on Fifth Ave. and continue around the loop to the starting point. The "Alley" elevated will turn into Congress St., east to Wabash Ave., thence into the belt line at Jackson or Van Buren Sts., and thence around the belt to its own lines at the starting point. The Metropolitan Elevated will enter the belt at Jackson St. and Fifth Ave., and thence around to the starting point; and the proposed Northwestern Elevated will cross the Wells St. bridge and enter the belt line at Lake St. and Fifth Ave. It is stated that the tracks are to be carried on a single row of columns and that arrangements are practically completed for sufficient right of way to assure the construction of the lines. The cost of the lines will be enormous, being estimated, according to published reports, at $5,000,000.

Compressed hay for paving is reported to be under trial by the Amies Pavement Co., of Philadelphia. Under heavy pressure in a Dederick hay press, the dry grass is pressed into cubes and then cut into paving blocks of convenient size. After being soaked in a drying oil it is claimed that the blocks become indestructible.

The new station for the Boston & Maine R. R. at Lowell, Mass., is nearly completed. It is wedge-shaped in plan, between converging tracks, and is built of New Hampshire granite, with North Carolina sandstone trimming and slate roof. The waiting room is 55 × 66 ft.; smoking room, 15 × 22 ft.; women's room, 18 × 25 ft.; dining room, 18 × 24 ft.; express room, 22 × 36 ft., and baggage room, 42 × 28 ft. The two latter rooms form a separate building, but under the same roof which covers the platforms. The architect was Mr. B. L. Gilbert, of New York, and the contractors were Woodbury & Leighton, of Lowell.

The Southern Pacific Ry. extension from Santa Margarita to San Luis Obispo, Cal., 16.75 miles long, which has just been opened for traffic, has several important works. There are seven tunnels on it, bunched close together, with an aggregate length of 1½ miles, the longest being 3,600 ft. and the next 1,300 ft. There is a steel bridge 900 ft. long and 72 ft. above the bed of the creek which it crosses, besides three bridges of 80 ft. span. The grade on the first three miles from Santa Margarita is a 2% ascent, and then for 11 miles beyond, toward San Luis Obispo, is a descent at about the same rate. The construction was begun Oct. 20, 1892, the contract for masonry, tunneling and other excavation being let to George Stone, of San Francisco, and J. A. McMurtry, of Denver, associated under the firm name of George Stone & Co. They agreed to complete the work in 18 months, and actually did it in 17 months. The tunnels are 16 × 22 ft., in serpentine rock, and are lined with timber. All the culverts are of stone masonry. The Steiner creek bridge is similar in design to the Pecos bridge, described in our issue of Jan. 5, 1893, but is of course a comparatively small structure.

STAND-PIPE ACCIDENTS AND FAILURES.*

By Prof. Wm. D. Pence.

(Continued from p. 395.)

Classification and General Discussion.

Table I. presents the subject of stand-pipe accidents and failures in a general manner by summarizing the principal points of the preceding record, and Tables II. to IX., inclusive, classify the general record under the several points of distinction, thus affording a ready means for studying the subject in its various phases.

It will be observed in Table II. that of the 28 cases included in the record, 17 were total failures, 5 failed partially, and in 6 of them only slight damage was sustained, making the number of total failures six greater than the combined number of less serious accidents. This excess is partly explained by considering other features of the classification, for which purpose the extent of damage sustained in each case is indicated in the subsequent tables. It is but just to say, however, that this relative excess of total failures may be due to the omission, from this record, of accidents in which the resulting damage was not serious; for, although, as was stated in the introduction, an extended search indicates that no accident of importance has been omitted, cases which were not serious enough to warrant general publicity at the time of their occurrence might easily have been overlooked.

A strict classification with reference to cause presents serious difficulties in a number of the accidents, making it necessary to take more or less license in the preparation of Table III., and inasmuch as the questions of cause and existing conditions are intimately related, the two items have been included in the one table. As might have been anticipated, Table III. reveals the fact that the most prolific source of accidents has been simple hydrostatic pressure or the combined effect of ice and water, there being ten instances of the former and nine of the latter, making ten more than the combined number due to other causes. Of the latter, six were due to wind pressure and three to defective masonry. It is also seen that cases of total failure are not confined to any particular cause, although 14 of the 17 total failures took place under the two heads first mentioned, only one occurring under wind pressure, and two being due to defective masonry.

It will be observed that of the six total failures shown in Table III. as having taken place in the presence of ice, four have occurred in 1893 and 1894 within a period of slightly more than twelve months. This startling fact suggests the need of a prompt reform of such a character as will insure protection from this fruitful source of danger, but reform is clearly impossible except in so far as the true elements of danger are known to those who have direct charge of this class of structures during actual operation. It should be stated that certain of the most powerful of the forces which may occur in the presence of ice are of so subtle a character and usually act so unexpectedly that distinct observations of their influence previous to actual rupture of the inclosing metal shell are almost entirely lacking. However, this deficiency may be largely supplied by a careful consideration of the meteorological and other conditions known to have existed at and for a sufficient period preceding the moment of failure. Although, as a rule, the stage of water in a stand-pipe is continually fluctuating, there are occasions when the water level may remain practically stationary for a considerable period of time. An instance of the latter condition is found in the case of Asheville, N. C., where the stand-pipe had been restricted to hold a reserve supply for fire purposes, and another in the case of East Providence, R. I., where the stand-pipe had been damaged by wind in its upper portion during construction and, pending final acceptance from the contractor, had been kept nearly full, probably for the purpose of preventing a repetition of the earlier accident. Since it is possible that an emergency requiring a fixed water level for a considerable period of time may occur in the life of almost every stand-pipe, due prominence should be given to this condition with respect to its influence upon the formation and action of ice. The following brief analysis of the phenomena of ice formation and action in stand-pipes is advanced in the hope of throwing some light upon this important subject.

With a fixed stage of water in the stand-pipe during a period of freezing weather, there may result:

(1) The formation not only of a sheet or cap of ice over the exposed upper surface, but also (2) the formation of a tube of ice against the inner cylindrical surface of the metal shell, with (3) the thickness of the ice walls along any element of the cylinder probably about equal throughout its height, but (4) usually with a more or less eccentric horizontal section to the ice tube, because of the action of the sun or warm winds on the south side or of colder winds on the north side of the metal shell; and (5) it is important to observe that the connection between the ice tube and the rim of the bed-plate will be watertight.

Now, with the ice cap and tube thus formed, we may have: (6) With a warmer period, melting may take place, beginning on the south side; (7) if the rise in temperature be sufficient in duration and amount, the ice tube will melt entirely loose from the stand-pipe; (8) the watertight connection with the base, mentioned in (5) above, will probably survive longest, particularly in case the water level is absolutely fixed; and (9) the water resulting from this melting will, of course, have a temperature of 32° F. and will trickle down between the two shells, forming a pocket having a height, perhaps, nine-tenths that of the ice tube.

(10) If, however, the melting loose be advanced

TABLE II.

Classification of Stand-Pipe Accidents and Failures with Reference to Extent of Damage.

Total failures.		
Cleveland,	Newport,	Wheatland,
Jersey City,	Franklin,	Asheville,
Cincinnati,	Seneca Falls,	Maryville,
Lexington,	Temple,	E. Providence,
Gravesend,	Defiance,	Peoria.
Kankakee,	Nappanee,	Total, 17,
Partial failures.		
Sandusky,	Caldwell,	Thomasville,
Sandusky,	Victoria,	Total, 5.
Slight damage.		
Asheville,	Defiance,	E. Providence.
Plattsmouth,	Stevens Point,	Total, 6.
Greencastle,		

TABLE III.

Classification of Stand-Pipe Accidents and Failures with Reference to Existing Conditions and Probable Cause.

Failure of metal caused by—		
Water.	Ice and water.	Wind.
Cleveland.....T	Jersey City...T	Caldwell.....P
Sandusky.....P	Greencastle...D	Victoria.....P
Sandusky.....P	Defiance.....D	Kankakee.....T
Cincinnati.....T	Stevens Point.D	Asheville.....D
Gravesend.....T	Defiance.....T	Plattsmouth...D
Newport.....T	Wheatland....T	E. Providence..D
Seneca Falls..T	Ashville.....T	
Temple.....T	Maryville.....T	
Nappanee.....T	E. Providence.T	
Peoria.....T		
Total 10	Total 9	Total 6

Failure of masonry caused by—	
Water.	During construction.
Lexington.....T	Thomasville.....P
Franklin.....T	
Total..... 2	Total..... 1

T denotes total failure, P partial, and D slight damage.

TABLE I.—GENERAL RECORD OF STAND-PIPE ACCIDENTS AND FAILURES.

	Location.	Date.	Year built.	Size (ft.) and capacity (galls.) Diam.	H't.	Cap.	Material.	Part which failed first.	Existing conditions and probable cause of failure.	Extent of damage.	
1	Cleveland, O.....	(?) 1868	.....	60	18	381,000	Wrought iron.	Side plates.	Full of water. Overstrained plates.	Total failure; burst.	*1
2	Jersey City, N. J...	Dec. 31, 1869	1859	6½—4	160	26,000	Wrought iron.	Side plates.	Full of water and ice. Damaged plates.	Total failure; buckled and burst	2
*3	Sandusky, O.....	(?) 1877 (?)	1876–7	3	229	12,000	Steel.	Side plates.	Outer stand-pipe full and inner pipe empty.	Partial failure; collapsed.—(Repaired).	3
*4	" "	Oct. 20, 1878	1876–7	3	229	12,000	Steel.	Side plates.	Inner stand-pipe full; during fire. Damaged plates.	Partial failure; burst.—(Repaired).	4
5	Cincinnati, O.....	June 29, 1881	1880–1	100	48	2,700,000	Steel.	Side plates.	During test; 39 ft. of water. Damaged plates.	Total failure; burst.	5
6	Lexington, Mo.....	June 22, 1885	1885	22	150	427,000	(Wrought iron).	Foundation.	During test; full. Defective foundations under columns of tank frame.	Total failure of tank and frame.	6
7	Caldwell, Kan.....	June 11, 1886	1886	12½	150	138,000	Steel.	Anchorage.	Cyclone; stand-pipe empty; during erection. Deficient anchorage.	Partial failure; overturned.—(Repaired).	7
8	Victoria, Tex.....	Aug. 20, 1886	1885	16	100	151,000	Wrought iron.	Upper plates.	Hurricane; upper 30 ft. empty. Thin plates (3-16-in.),	Partial failure; collapsed in empty portion.—(Repaired).	8
9	Gravesend, N. Y...	Oct. 7, 1886	1886	16—8	250	172,000	Steel.	Side plates.	During test; 227 ft. of water. Poor design; defective plate.	Total failure; burst.	9
10	Kankakee, Ill.....	Oct. 14, 1886	1886	20	124	291,000	Wrought iron.	Anchorage.	Gale; empty; previous to test. Deficient anchorage; thin upper plates (⅜-in).	Total failure; collapsed; overturned.	10
*11	Asheville, N. C.....	Mar. 28 (?), 1887	1886–7	45	60	713,000	Steel.	Upper plates.	Storm; empty; previous to test. Deficient top stiffness.	Slight damage; collapsed.—(Repaired).	11
12	Plattsmouth, Neb..	April 9, 1887	1886–7	25	80	294,000	Steel.	Anchorage.	Storm; empty; during repairs. Deficient anchorage and top stiffener.	Slight damage; collapsed; anchor bolt broke.—(Repaired).	12
13	Newport, Ark.....	May 19, 1887	1887	24	20	68,000	Wood, w.i. hoops.	Hoop.	During test; full of water. Overstrained hoop.	Total failure of tank and frame; burst.	13
14	Franklin, Mass.....	Oct. 27, 1887	1884, 7	40	35	329,000	(Wrought iron).	Brick tower.	Green brick tower; 25 ft. of water in tank; pumping. Defective brickwork.	Total failure of tank and brick tower.	14
15	Seneca Falls, N. Y.	Oct. 27, 1887	1887	30—27¾	130	637,000	Steel.	Side plate.	Four months after completion; full of water. Defective plates.	Total failure; burst.	15
16	Thomasville, Ga...	Dec. 6, 1887	1887	25	30	110,000	(W. i., not erected).	Brick pier.	Outer brick tower completed and inner pier nearly so. Vibration from hod elevator.	Partial failure of tower; central pier overturned.	16
17	Greencastle, Ind...	Jan. 21, 1889	1888	22	40	398,000	Wrought iron.	Inside ladder.	Excessive ice formation; inside ladder; partially empty. Fall of ice.	Slight damage; ladder broken down.—(Ladder removed).	17
18	Temple, Tex.....	Oct. 25, 1890	1890	20	120	282,000	Steel.	Side plate.	During test; full of water. Defective plates.	Total failure; burst.	18
*19	Defiance, O.....	Feb. 8, 1891	1888–9	22	140	398,000	Steel.	Side plate.	Ice cap; pumping. Damaged plates; falling ice.	Slight damage.	19
20	Stevens Point, Wis.	Mar. 13, 1891	1888	20	140	329,000	Wrought iron.	Side plate.	Ice; top angle inside; partially empty. Fall of ice; defective plate.	Slight damage; plate bulged and cracked.— Repaired).	20
21	Defiance, O.....	Mar. 29, 1891	1888–9	22	140	398,000	Steel.	Side plate.	Full of water and ice; pumping. Damaged plate.	Total failure; burst.	21
22	Nappanee, Ind.....	Aug. 25, 1892	1892	24	20	68,000	Wood, w.i. hoops.	Hoop.	During test; full of water. Overstrained hoop.	Total failure of tank and frame.	22
23	Wheatland, Ia.....	Jan. 16, 1892	1892–3	20	20	47,000	Wood, w.i. hoops.	Hoop.	Ice; 17 ft. of water; severe weather. Overstrained hoops.	Total failure of tank and frame.	23
*24	Asheville, N. C.....	Jan. 22, 1893	1886–7	45	60	713,000	Steel.	Side plate.	Ice; 47 ft. of water; sudden fall in temperature. Damaged plates.	Total failure; burst.	24
25	Maryville, Mo.....	Feb. 28, 1893	1886	18½	135	271,000	Steel.	Side plate.	Ice; 100 ft. of water; rapid rise in temperature; inside top angle Fall of ice.	Total failure; burst.	25
*26	E. Providence, R. I.	Sept. 7, 1893	1893	40	125	1,175,000	Steel.	Upper plates.	Cyclone; empty; during erection; top course lacking. Deficient top stiffness.	Slight damage; collapsed.—(Repaired).	26
*27	" "	Jan. 19, 1894	1893	40	125	1,175,000	Steel.	Side plate.	Less than 100 ft. of water. Ice.	Total failure; burst.	27
28	Peoria, Ill.....	Mar. 30, 1894	1890	25	120	441,000	Steel and w.i.	Steel plates.	One hundred and five feet of water; calking; wind. Defective steel.	Total failure.	28

*Two accidents to the same stand-pipe: 3, 4 (inner stand-pipe) Sandusky, O.; 11, 24, Asheville, N. C.; 19, 21, Defiance, O.; 26, 27, East Providence, R. I.

* Copyrighted, 1894, Engineering News Publishing Co.

only so far as to have formed a pocket or film of water on the south side of the stand-pipe between the ice and metal shells, and at this juncture (11) the process of melting is interrupted by a sudden reduction of temperature such as often occurs during a single night in the winter season, there would be (12) a re-freezing of the water contained in the isolated pocket above described, and this process would probably begin at the top and in the thinner edges of the film. As is well known, the congelation could proceed only so far as space for expansion were available; so that after the upper limit of the pocket had been closed, the process of freezing must cease, except as space is gained by stretching the outer metal shell or by deflecting or compressing the inner ice arch, or both; for as above stated in (5) there is no communication at the base between the confined pocket and the main body of water within the stand-pipe.

Under these conditions (13) the strains produced in the metal shell are enormous, and in an extreme case immediate failure, either of the metal shell or of the ice arch, is highly probable. It is of interest to observe that (14) the strains may be materially increased by a rapid and considerable reduction of temperature which will contract the metal shell, although this element may be entirely nullified by a corresponding reduction in the ice tube from the same cause, and (15) the pressure of the inner body of water acts in a relatively slight degree to prevent the deformation of the arch and thus to increase the strain on the metal shell.

(16) The phenomena above described may occur in a mild form repeatedly in the same stand-pipe with little or no damage, or a weakness so developed may subsequently lead to the total failure of the structure at a time when the nominal strains are entirely insufficient to account for the failure. Reference to the descriptive record of ice failures shows that but two stand-pipes (Asheville and East Providence) have failed under the critical conditions above outlined, a fact which suggests the inquiry as to why no others have thus failed. The answer is found (17) perhaps mainly in the usual gradual fall of temperature which permits the full action of the plastic qualities of the ice tube, which thus conforms itself to the powerful expansive force. (It should here be stated that it has been found by careful experiments that the plasticity of ice is insensibly increased by the presence of air bubbles, such as exist in the ice which usually forms in stand-pipes, and it is also of importance to note in the same connection that the plasticity of ice is considerably greater at and very near the freezing point than at lower temperatures.)

(18) The scarcity of such failures may also be traced to the fact that the dangerous pocket always forms along the weakest line of the eccentric ice arch, and it is probable that the cracking sounds heard within both the stand-pipes above mentioned some time previous to their failure were due to the partial giving way of the ice tubes, thus proving that the force had been in action, perhaps intermittently, for a considerable period of time. It is thus seen that the eccentricity of the ice tube may act as a safety valve for the relief of this force, so as to avoid actual failure of the structure.

(19) Although no actual observations have been made to that effect, it seems entirely possible that water which had leaked into poorly filled rivet holes might lead to serious weaknesses, if not actual fracture, by freezing, provided the metal be so brittle in character as to have led to serious damage in the process of punching. The possibility of such damage would, of course, be much increased by "cold shortness" in the metal.

It is thus seen that this force is a most severe test of the quality of plate metal. Although the two stand-pipes which have thus failed were of steel, the magnitude of the bursting force was doubtless such as to render the kind or quality of plate metal of little importance. As to the amount of the force of freezing water, little of a definite character is known. A single test (made at Florence about a century ago), by bursting a 1-in. hollow brass globe, indicated that this force may exceed 30,000 lbs. per sq. in., and in a more recent test (made in Germany) with a cast iron bomb-shell, a force of about 6,000 lbs. per sq. in. was indicated. The measure of the force in each case was the tenacity of the metal, which is probably quite unreliable because of the uncertain extent to which the low temperature may have acted to modify its strength. The meager results of an extended search for records of this class of tests suggests the need of a series of experiments along this line to be conducted upon a reliable basis.

Considering now the more usual case of the fluctuating stage of water in the stand-pipe, there may result during a period of freezing weather:

(20) An ice cap usually quite thin in any particular sheet, but, owing to the formation of successive sheets, the ice accumulates in a thick but irregular mass within the limits of the daily fluctuations.

(21) A tube of ice forms against the inner surface of the metal shell, but (22) the thickness along any element of the ice cylinder is greatest at the cap mentioned in (20) above, and decreases downward.

(23) As in condition (4), with a fixed stage, the ice shell may also be more or less eccentric in the thinner portion, but the difference in thickness will probably not usually be noticeable in the irregular upper portion.

(24) The ice tube may originally form a tight connection with the bedplate, but the influx of warmer water soon melts the lower portion of the tube away or so reduces its thickness and strength (on the south side, at least) as to make the formation of an isolated pocket, such as is described in (9), quite improbable. (It is proper to mention a possible exception to this statement where the solar rays may be effectually cut off from the lower portion of the ice tube by the proximity of a building on the south side of the stand-pipe.)

(25) and (26). (Same as for fixed stage.)

(27) With the melting loose, the space between the ice and metal shells is directly connected with the inner body of water, and (28) the water in this connected pocket of course finds the level of the main body and quickly acquires a temperature of 32° F.

(29) With entire melting loose, the mass of ice floats freely, and with a full tank is buoyed up beyond the top rim of the stand-pipe, unless prevented from so doing by an obstruction at the top.

(30) If, while in this position, a sudden and considerable fall of temperature takes place, the ice tube may freeze fast, and (31) if the water level is low at the moment when the mass of ice becomes detached (either by thawing, or by the action of gravity, or both) more or less damage and perhaps the total failure of the stand-pipe may result, depending, of course, upon the energy developed in the fall of the ice.

Returning to condition (20) it will be seen that (32) with weather of unusual severity a thick and perhaps airtight cap of ice may form during a brief period of fixed water level; (33) such an ice cap may prove to be a source of danger to the stand-pipe itself by an explosion similar to that which occurred in connection with the earlier Defiance, O., accident, or (34) it may seriously cripple the efficiency of the system in case of a fire or other sudden large demand upon the supply. These dangers from the ice cap may, of course, occur with either a fixed or a varying stage of water.

Returning to condition (28) we may have:

(35) With a sudden fall of temperature, the melted space may re-freeze, but without danger to the stand-pipe, because of the free connection between the main body of water and the pocket.

(36) With a continued reduction in temperature, the ice shell will contract more rapidly than the metal shell of the stand-pipe, owing to the fact that the coefficient of expansion of ice is several times greater than that of the metal, and this excess in the reduction of the ice tube will be displayed in the formation of cracks. These cracks immediately fill with water, which in turn is frozen, so that the ice tube may fill the metal shell perfectly at the lowest temperature.

(37) If it were now possible to raise the temperature of both ice and metal shells alike, a constantly increasing force would result from the excess in the rate of expansion of the ice, and rupture of the metal would soon result; but (38) it seems scarcely possible that the sun, which is, of course, the most powerful source of heat to be considered in this connection, can ever act with sufficient power upon the south side of a stand-pipe in the winter season to raise the temperature of thick walls of ice throughout to the point where this expansion will reach a critical stage, for either (39) the ice in contact with the metal would be melting by the time the temperature of the more remote ice were raised to the necessary point, or (40) the increase in temperature would be so gradual as to allow the plasticity of the ice, already mentioned, to relieve the pressure. As a matter of fact, it is probable that the temperature of the metal shell exposed to the direct rays of the sun is always enough above that of the contiguous ice to compensate for the above-mentioned excess in the rate of expansion of ice.

The foregoing outline of ice phenomena in stand-pipes is here presented for the first time, and it is doubtless not free from errors and omissions. The importance of the subject invites closer consideration than is here given to it, but the space required for other essential matters in this discussion forbids further extension of this interesting subject.

FALLS-OF-SCHUYLKILL BRIDGE; PHILADELPHIA & READING R. R.*

By W. B. Riegner.

The principal object in building the new bridge at Falls of Schuylkill, Philadelphia, was to provide a direct connection for trains running between Wayne Junction and the junction of the Philadelphia & Reading and Baltimore & Ohio railways at Girard Ave. station. The bridge consists of an 80-ft. stone arch over the East Park Drive, and eight deck-plate girder spans, one of 60 ft., one of 92 ft. and six of 87 ft., c. to c. of piers, over the river and adjacent low ground and West Park Drive. The bridge carries two tracks, 13 ft. c. to c. The alinement is a 6° curve and the grade is 0.25% rising to the east.

The river piers were founded upon the rock bed of the river. A floating cofferdam was used for this purpose, similar to one used some years before for removing rock obstructions from the canal channel, by Mr. E. F. Smith, and described by him in No. 4, Vol. IV., of "Proceedings." When in position for work, the dam is rectangular in shape, 62 ft. long and 36 ft. wide (outside dimensions) and 16 ft. high. Each side consists of timber crib work 10 ft. wide, making the inside dimensions 42 × 16 ft. At each corner there is a movable timber extending vertically from the bottom of the crib to some distance above the top. These timbers or spuds are shod with iron on the bottom, and serve to hold the dam in position while the sheet piling is being driven. The dam is divided vertically through each short side into two equal parts, which can be floated separately to any desired position and afterwards joined together. Water-tight compartments are built in each section to assist in floating it, and these compartments are also used to hold stone when it is desired to sink the cribs.

When the two sections are united and placed in required position, the spuds are dropped and the crib work is sunk by letting water into the water-tight compartments, and putting in the necessary amount of stone. Any irregularity in bearing between the bottom rock and bottom of crib is then corrected by a diver, who blocks up where required. Close sheet piling of jointed plank three or four inches thick is then put on the outside and spiked to the cribs. Puddle, composed of clay and gravel, is thrown around the bottom outside, and the dam is ready to be pumped out. On account of the length of the dam, 42 ft. inside, two sets of braces were put across from side to side as the water was pumped out. When the masonry reached the height of the braces, they were taken out and the dam was braced against the masonry.

The maximum depth of water encountered at Falls bridge was 13 ft. at ordinary water level. Several freshets occurred during the progress of the work which did some damage to the dam. At one time, when a dam was ready to be pumped out, a rise in the river moved it down stream about 30 ft., tearing off the sheet piling. It was drawn back to place and successfully completed. To make a complete shift of the dam from one pier to the next, with a gang of six men, required about six or eight days, divided as follows: To take the dam apart and reset it, about three days; to sheet pile, about two days; to puddle, about one day; and pumping out and puddling meanwhile required about one to two days, depending on the amount of the leakage. At each shift a portion of the plank sheet piling, perhaps 10%, had to be replaced by new stuff. The pump used was located on a small steamboat, and was run by a steam engine. The amount of pumping required after the dam was once pumped out varied for the different piers; some dams requiring little pumping and others a good deal. Only one of the foundations required much leveling off of the river bed, and this one also gave considerable trouble to keep the water out; but the leaks were

* From the Proceedings, Engineers' Club of Philadelphia. 1894. No. 2. For illustrations of the structure see Eng. News, Jan. 24, 1891.

finally stopped by using gunny bags around them, the bags being drawn into the crevices by the force of the water, thus holding the puddle.

The floating dam was used for the three piers in the river channel, the two piers near the shore being put in with ordinary dams. The floating dam is still in good condition and could be used again if needed. The original dam, of which the one used at Falls bridge is an enlarged copy, was used for 23 or 24 settings.

The iron superstructure consists of eight double-track deck plate girder spans, varying from 60 ft. to 92 ft. The metal is wrought iron; no steel being used. The girders are all 90 ins. deep out to out of angles, and are, on account of the curvature, spaced 8 ft. c. to c. under each track, instead of the usual Philadelphia & Reading R. R. standard of 6 ft. The bed-plates on the piers are continuous under the bearings of the adjacent spans for each line of girders, in order that the force developed by the expansion and contraction of the girders will be transmitted through this plate, and not through the coping. A solid plate floor with stone ballast was put on the 92-ft. span over the west drive, to comply with requirements of the Park Commissioners. This was made of Pencoyd trough-shaped sections; section B, 53 lbs. per yd., equal to 27.6 lbs. per sq. ft. of surface covered. The other spans have Philadelphia & Reading standard wooden floor, with yellow pine ties, 9 × 12 ins. and 12 ft. long, spaced 16 ins. c. to c. The 4 ins. superelevation of outside rails is made by blocks on top of the ties. Speaking generally, the iron work is the usual plate girder construction designed for 125-ton engines.

The span over the East Park drive is a stone segmental arch of 80 ft. span and 26 ft. rise. It is the longest arch span on this railway, though only 2 ft. longer than the spans of the adjacent skew arch built in 1854, which are 78 ft. The ring has a thickness of 3 ft., both at the crown and springing line. The backing is covered with a 6-in. layer of concrete, and this by 1¼-in. layer of asphalt, for the purpose of preventing leakage through the arch. This has been fairly successful, though there is a slight leakage under the haunches. The surface water on the west half of the arch is carried, by means of an iron pipe, through the north face of the arch, while that on the eastern half drains into the earth filling back of the arch. There is no earth filling above the arch.

The arch center consists of eight ribs placed 4 ft. 2 ins. apart c. to c., 17 ft. 9 ins. high and 70 ft. long measured on the horizontal bottom chord. The center was so designed as to give a clearance of 12 ft. over the Park drive, which placed the bottom chord of the ribs 8 ft. above the springing line of the arch. The ribs thus did not extend the full length of the ring by about 10 ft. on each side, so that it was necessary to attach an overhanging portion to each end. The top and bottom lines of the ribs were each made of two 4 × 12-in. pine planks, 6 ins. apart in the clear, to allow the 3 × 12-in. hemlock diagonal bracing to pass between them. All intersections were tree-nailed with 2-in. oak. The logging was 3-in. yellow pine. The ribs were supported near the ends on two trestles 33 ft. long, parallel to the springing line, 67 ft. apart. These trestles contained the wedges for dropping the centers, one wedge in each trestle. The wedges were of oak, 34 ft. long, made from 12 × 12-in. sticks, and bore against oak blocks set in the bottom sill of the trestle and in the mud sill. The wedges and bearing blocks were both greased when they were set up, in order to insure easy driving, when the centers were to be dropped. The quantities in the centering were as follows: Oak, 2,000 ft. B. M.; hemlock, 17,000 ft. B. M.; yellow pine, 30,000 ft. B. M.; total lumber, 49,000 ft. B. M.; iron, bolts, etc., 2,000. lbs.

The method of setting the keystones was as follows: The stones were dropped into position and iron wedges were driven on each side, making an equal joint between the key and the adjacent stones. This joint was then filled with cement. The center was dropped about two weeks after the keystone was put in, the entire masonry being in place at the time. The wedges were driven by striking them with a heavy piece of timber, handled by a number of laborers. Levels were taken on top of the key after it was set, and again shortly after the center was removed, to determine the amount of settlement. This was found to be ½-in. at one end and nothing at the other.

The work was commenced in May, 1889, and finished in February, 1890; considerable time having been lost by a change of contractors and by floods in the river. The cost of the work was as follows: The movable cofferdam cost about $3,000 to build, including one set of sheet piling. The total cost for cofferdams, including two crib cofferdams, for the piers at the edges of the river, and pumping, was $14,000. The contract price for the arch was $15 per cu. yd., which price included furnishing the falseworks. The price for pier masonry was $12 per yd., exclusive of cofferdams. The cofferdamming was done by the railway company. The entire cost of the bridge was about $175,000, including the short approaches.

CORROSION OF PIPES BY ELECTRIC RAILWAY CURRENTS.*

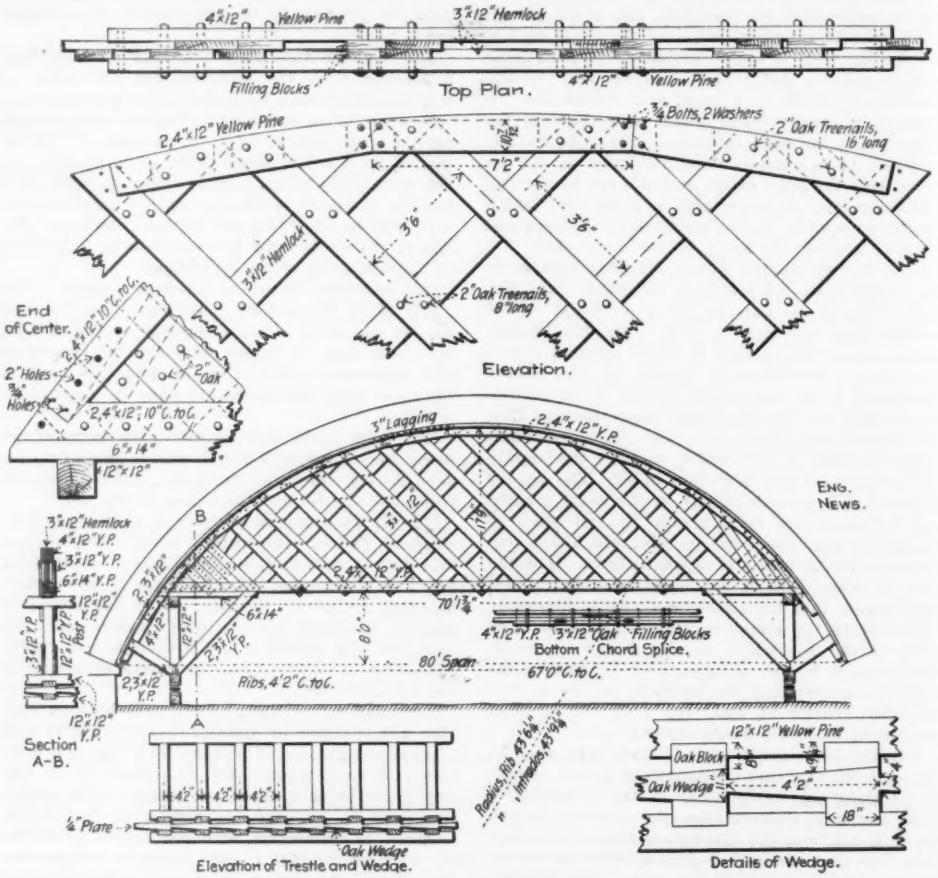
Prof. Geo. W. Plympton.—We have a large mileage of trolley in Brooklyn, and our first experience with electrolysis dates from about a little more that a year ago. We had heard of that in Boston, of course, before we had any experience in Brooklyn. In framing the franchise for the trolley roads there was fortunately a clause inserted (not through any provision of the aldermen or commissioners) which placed responsibility upon the trolley companies for any mishaps to any underground pipes, wires, cables or the like. That was placed there, not because electrolysis was thought of at the time, I think, but because it was supposed that in the process of digging up streets they might interfere with gas and water pipes, so that the responsibility is clearly acknowledged and they accept the situation, and they are taking all the means that they can with due regard to economy, which they always observe, of course, to prevent any serious deterioration. So in their experimenting, as there are four companies and four sets of engineers, their experiments have been to some extent along different lines. I am sorry to believe that we have not got the full measure of the damage that has been done, but only such as has made itself known through the entire failure of pipes and cables. It is reasonable to suppose that ten times as many examples could be found which would be nearly as bad, because there has been no digging down in the ground in search of such cases of corrosion. Water pipes, gas pipes and lead coverings of cable have all suffered. Telephone companies were the first to find it because of slight perforations of the insulation. Leakage of water pipes have made themselves known in one or two cases where they were near enough to the surface. In one of the cases exhibited, one pipe had been destroyed in three or four months. It was an iron pipe very near the rail. It was replaced by a larger pipe, and that was perforated in thirty days. So that the rapidity of the action warned us there that it was time to look about quite actively. The seventh conclusion of Mr. Farnham's paper is that "a large conductor extending from the grounded side of the dynamo, entirely through the danger territory and connected at every few hundred feet to such pipes as are in danger, will usally insure their protection." True, so long as that connection can be kept up. Will it not be necessary to make such a connection in such a place that we can examine it every once in a while? Will it do to make a connection and cover it up? What shall it be—copper wire? Can we solder a copper wire to an iron pipe? Can we make a connection that will remain good and without increasing its resistance? Local action will set up a corrosion, and as to soldering, in the ordinary sense of the term, it seems to me impracticable. So that we have some fears that whatever precautions they take of that kind may prove insufficient after a little while, or else that they will need constant attention, and that we shall need a large corps of inspectors to prevent serious injury.

The numerous ways of bonding the wires are the things that the trolley people exhibited there as the means of preventing injury, and two or three have been exhibited in the last week or two. One, that of making the rail continuous, has been, I believe, tried in Boston. It is about to be tried in 39th St., Brooklyn. The apparatus arrived the other day for welding the rails. The engineer of the company assured me that they would make their rails continuous within the limits of the city. Another bond, which bears the name of Vail, I think, has been suggested, where three large rivets are made tapering, and driven into the rail and riveted down, each rivet, ½ in. diameter, and then with a ½-in. conductor extending beyond the joints, and then another set of three rivets. That has been exhibited as one of the best bonds that is known. Of course, as Mr. Farnham says, the current will still be divided between the rail and the moist earth in proportion to their relative conductivities. You cannot convey all of that current back by the best conductor that you can put in the ground. So the method of relieving the pipes of that positive charge, where the corrosion has been set up, is the best way to insure the protection. But in regard to its permanency, as I said before, I am inclined to feel some fear.

Mr. Townsend Wolcott.—One very interesting point is the small voltage which will corrode a cable in the earth. We are generally familiar in electrolyzing solutions with voltages of one volt or over—almost any solution—over one volt. But I take it that the conditions in the damp earth are such that the corrosion is just about ready to go on anyway, and a very little help will make it go.

Mr. A. E. Kennelly.—I differ from some of the generalizations which Mr. Farnham makes. I think that it is not, as stated in the sixth generalization—that it

* Abstract of discussion on Mr. Farnham's paper on "Destruction of Metal Pipes by Electrical Currents" (Eng. News, May 3), from the Transactions of the American Institute of Electrical Engineers.



ARCH CENTERING FOR FALLS-OF-SCHUYLKILL BRIDGE; PHILADELPHIA & READING R. R.

is not necessarily good policy to connect the positive pole of the dynamo to the trolley lines, for the reason that supposing you are grounding one terminal of your dynamo which is supplying a total current distributed to your trolley wires, say, of 1,000 amperes, that current goes into the ground on your district, and it has to come out of the ground at the point of your ground connection to the dynamo. Now, if you bury in the ground a large mass of iron pipe, or lead tube, or metallic conductor of any kind, that metallic conductor will, perhaps, absorb a large fraction of the 1,000 amperes. Let us say it absorbs 750 amperes. The metallic system will have 750 amperes entering it and 750 amperes issuing from it. Now, when you have the negative pole to line, the current will go from your ground plate, will enter all this mass of metal in the vicinity, and there it will do no damage, because where it enters the iron or lead, hydrogen is given off. But it will issue from the iron or lead over a larger area in the remote districts—a very large "danger" area, an area as shown on the chart this evening of several square miles. That large area will be in danger of corrosion, and there will be corrosive electrolysis going on all over that area to the extent of 750 amperes collectively. But when you reverse the current, as is suggested as advisable in the sixth conclusion of this paper, you reverse that condition of affairs. All the distant district is free from danger and all the oxidizing and corroding effect is close to you; but the 750 amperes are still there and are now actively corroding a much smaller surface.

While all admit that iron is corroded, and iron pipes are corroded electrolytically, I do not think that Mr. Farnham means that as much corrosion takes place with iron as with lead, for the reason that we all know a given weight of lead is much more readily consumed by electrolysis than a given weight of iron. Roughly, an ampere in a year will dissolve 75 lbs. of lead by electrolysis. It will dissolve, roughly, only about 20 lbs. of iron, or nearly four times less. So you have a more reduced activity *of* corrosion on an iron plate than on a lead plate, and that is reduced again by the fact, in actual practice, that in water mains, the electrical conduction from length to length of pipe is very imperfect.

The destructive effect of electrolysis, while it is serious, is often exaggerated by not taking into account the actual amount of decomposition that can take place, electrolytically, under the most favorable circumstances. If you have a mile of 8-in. water main, which is ½-in. thick, that is, its exterior diameter is 9 ins. and its interior diameter is 8 ins.; and a thousand amperes are kept steadily flowing day and night, with uniform density, out of that surface into the surrounding soil, it will take about six years for that current to reduce, by electrolysis, the thickness of the iron to one-half. Of course it would be unfair to make a positive statement of that kind, because we assume uniform corrosion, whereas corrosion does not take place uniformly.

The resistance of the ground is really far higher than we ordinarily attribute to it. We are so accustomed to use the ground universally in telegraphy, we are so accustomed to the idea of a ground return circuit with very little resistance in it, that we come to grasp the idea, unconsciously, that the ground has very low resistivity, whereas it has very high resistivity. We may take the position, in fact, that the ground itself has an enormous resistivity, and what we really measure in the resistance of the ground is the resistance of the water that happens to be suspended in the ground. The resistivity of ground under ordinary circumstances is something like 50 or 60 ohms. The result is, that if you had two iron water pipes, each 9 ins. in diameter, deeply buried in the soil and 30 ft. apart, at a constant difference of potential of 10 volts, you would not expect less than 2.5 ohms resistance between the pipes per linear foot of either, nor more than four amperes of current between them per linear foot. In the case of 10 volts between one such buried pipe and two surface track rails, supported on wooden sleepers, the resistance between track and pipes would probably be much more, and the current strength per linear foot of pipe perhaps less than one ampere.

Mr. Farnham.—The conclusions summarized in my paper were written with the thought that they should be considered together in all cases. There would be no advantage in doing some of this work suggested unless we did other parts of it also. Conclusion No. 6 was intended to go with No. 7. But if that had not been the intention, I can hardly agree that it would be more serious to have the corrosion take place in a limited territory, even though it were more rapid, than in a large territory. Would it be more convenient to dig up all the paved streets of a large city once in ten years or to dig up a radius of a thousand or of two feet once in a year? It is an open question which hydraulic and gas engineers must pass upon. But it would seem to me better to confine the trouble in a small territory, even though you had to take other measures, put in larger pipes if you please, in that territory, rather than have the destruction slowly but surely going on all over your city.

As to the number of years that may elapse before pipes will be eaten through, is a question we hardly need to discuss. If the action is slow it ought to be prevented. We may easily determine whether there is danger or not, and whatever we do to remove the danger by these means, we must watch the electrical conditions constantly or we shall find ourselves again in trouble. In illustrating this fact let me say that since the system just described has been applied in Boston, the West End company has run out in one direction several large return wires in addition to those previously in use in that locality, and thus practically moved the power station, that is, it changed the zero line from its former location to a point very distinct, making it necessary to rearrange and extend the cable return wire system.

If you extend the return wire throughout the entire railway district, and connect it at frequent points to the water or other pipes, as I understand has recently been done in Milwaukee, you may prevent a difference of potential between the rails and the pipes, but you will not wholly prevent a difference of potential between the pipes and the earth. You will simply transfer the action from the pipes near the power station to those in more distant territory; for in this case the current will naturally leave the pipes at the same point it now leaves the rails, though in a less quantity. Imagine, now, an opposite extreme; the return wire from the rails is made small, or removed altogether, while the return wire from the pipes extends over the danger district. You will see the current all returns by the pipes and pipe return wire; the current passing at all points from the rails through the earth to the pipes raises the potential of the earth above that of the pipes and so assures protection to the latter. This is an extreme measure and may never be necessary, but should it be found so, as the railway companies cause the trouble it is to be presumed they will be willing by such means to transfer the electrolytic action from pipes to the rails.

Dr. Leonard Waldo.—The coal miners have had much trouble in keeping their valves from disappearing and their pipes from being eaten up, and inasmuch as we have been interested in the metallurgy of that sort of thing lately, we have looked into the question. In several instances we have had valves, parts of pumps and similar articles sent to us from the depths of the mine, and several gallons of the water which was supposed to do the mischief sent along with them. We boiled the water holding specimens of the metal of which the valves were made, and exposed the specimens for weeks at a time, with no chemical action at all on the metal similar to that used in the valves or in the pipes. When you insert an iron pipe and connect the two specimens through a voltmeter, you will get a very rapid disintegration of one pipe or the other, and you get an indication of anywhere from four to six-tenths of a volt. It is my observation that very efficient deterioration of these underground materials of different potential takes place with differences under half a volt. There is another question which has come up in our minds and I have not heard it touched upon to-night, but I think it is a fundamental question in talking about deterioration of metals under electrolytic or acid or water action. The lead which our friends use for sheathing cable is probably over 95% lead, but it certainly is anything but pure lead, and the secondary couples that are formed with antimony or the other impurities that the lead contains when brought in close contact with the acid waters, even having a very small percentage of acid in them, produce a corrosion of the surface which I do not see any way of taking account of. The difference between a copper pipe containing 0.1% of certain impurities and containing 1% of the same impurity is very great. But it is no greater than that which contains none at all, and that which contains 0.1%. In all these questions, therefore, of rapid deterioration of pipe and that sort of thing, I think, the most important consideration will have to be given to the actual corrosion which occurs because of the molecular, chemical and electrical actions which take place between the metal and its own impurities. As to the small voltages existing and having the effect of corrosion, I think any one who has actually made measures on those pipes in position, with and without the presence of electrical action, is quite prepared to testify that the smaller voltage and the corrosion of the pipes are present at the same time; whether the corrosion is wholly due to the action of the current on the principal metal alone or not is quite another question.

Mr. C. G. Armstrong.—There seems to be no practical difficulty in the use of the two trolleys. They are running in many places to-day with a fair degree of success and I believe if it had not been for the violent opposition of one of the large companies, as suggested here to-night, it would have been used much more extensively than the single trolley. I really do not see after all why it is not the best way out of the present difficulty. It certainly would not cost as much to run a double trolley system as it would to run a complicated system of underground returns connecting to all water, gas and other pipes and what not that we meet in the street. The system advocated by Mr. Stetson, of an underground double trolley, or a similar system with his catch-box elevated on posts between the tracks, would afford another method of accomplishing the same end.

If electrical engineers would lay aside the creeds laid down by their various commercial interests and attack the problem from a purely scientific standpoint, following out the practice of electric light engineers, viz., insulate both poles from the ground, the question of electrolysis would be solved just as the metallic circuit has solved many more serious problems in telephony.

Mr. A. V. Abbott.—The double trolley system certainly does afford a perfect solution of the question, but only at the expense of a greater investment of capital in the original line of construction, as the amount of copper required for a double system over that needed with the single wire would be increased about fourfold, and as much complexity would be involved in the erection of the wiring. The objections to the double trolley system, other than those of increased capitalization, are entirely mechanical ones and in ordinary lines can be overcome. The double trolley, about three years ago, still survived, and it is probably chiefly due to the Thomson-Houston company that it does not still exist.

In all railways which are reasonably straight and do not encounter a great number of intersecting lines, the introduction of the double trolley is not a serious obstacle, and by affording to the street railway an independent return places the railway circuit entirely under control of the railway managers, presenting to the company in this respect considerable advantage. It is probable, nay, almost certain, that should street railway companies be obliged to protect all present existing underground structures by means of special return feeds, as indicated by Mr. Farnham, the expense of these feeds and their introduction would be considerably less than the original cost required to equip the line with a double trolley system.

Personally, I have always been in favor of all electrical companies operating entirely upon metallic circuits which should be peculiarly and appropriately their own. I think the advantages to be derived from this principle of operation will, sooner or later, be appreciated, and that street railway companies, electric lighting companies, telephone corporations, in fact, all electrical industries will, in the not far distant future, be each equipped with its own individual and independent complete circuit.

The presence of overhead wires in the crowded city streets is constantly urged as an objection to the trolley system, whether it be single or double. Inventors have been constantly called upon to devise methods whereby the streets could be relieved from this objection.

A conduit electric road is at the present time perfectly feasible, and its successful construction and operation are merely a question of the amount of capital that the promoters are willing to invest. Ordinarily speaking, an electric road can be built and equipped in running order at an expense of from $30,000 to $40,000 per mile, including all items, excepting that of real estate, franchises and buildings. The cable road is typical of the conduit system, and is always expected to cost from $125,000 to $150,000 a mile. The widespread and rapid introduction of electric roads has chiefly resulted from the fact that they require so much smaller capitalization in the outset, and that they, therefore, may be introduced in districts that are not thickly settled, in which the traffic could never be made to pay the interest and depreciation on the more expensive cable plant. Cable roads could never, for a moment, be considered in many of the districts where electrical roads are now successfully and remuneratively operating, having superseded animal traction.

If a street railway company is willing to invest in an electric road the same amount of capital as is called for by the ordinary cable road, a successful conduit system can be at once introduced, the success of the conduit electrical road simply depending upon its being built well enough to do the work required of it.

In a consideration of the return system for an electric road, the railway company should not forget that by providing an adequate return circuit, which will protect other underground structures, they are not only securing immunity for themselves from damage suits, but at the same time are putting more money into their pockets in a saving of coal pile than the interest and the depreciation upon the investment involved in the return circuit will amount to.

In building some 300 miles of electric road I have universally found that the grounded return circuit ab-

sorbed more energy from the station than any other part of the line, the car motor only excepted. In one instance in mind the return circuit of the road was so poor, owing to defective rail bonding and the dry condition of the soil, that, in many instances, the rail bonds had actually burned their way through the ties of the road and allowed the rails to separate.

In another instance, motor repairs were reduced several hundred dollars a month by the addition of an appropriate amount of feed wire.

In a third case, the amount of power required for operation was reduced to 80 HP. by the provision of an appropriate return.

I feel quite confident that if the engineers of the majority of electric railways in this country would carefully study their circuits, making accurate measurements thereon, they would be immediately convinced that the expenditure required for an appropriate return circuit which could in a majority of instances be arranged to protect existing underground structures, would result in an actual saving to them in fuel, and would be an investment upon which they could immediately enter.

THE NIAGARA FALLS POWER PLANT.

(With inset.)

The great engineering work which has been in progress for nearly four years for the development and utilization of the water power of Niagara Falls for commercial purposes is now approaching completion, and by the middle of the current year the Niagara Power Co. will probably be ready to supply electric power from the three 5,000-HP. dynamos which will form the preliminary installment of electric power-generating machinery. The progress of this work has been noted in Engineering News from time to time with many of the more important structural features illustrated and described in detail. With the near approach of the work to completion, however, it seems desirable to review somewhat more fully the various engineering problems which have necessarily been encountered in designing and constructing a work of so great magnitude. This we are able to do quite completely through the courtesy of the Cataract Construction Co., which has carried out all the work of construction for the Niagara Power Co.

The first comprehensive plan for the use of the water power at Niagara Falls was the construction of the hydraulic canal now owned by the Niagara Falls Hydraulic Power & Manufacturing Co., although small canals, or more properly flumes, to individual mills had been constructed as early as 1725. The hydraulic canal was completed in 1861, and since that time the building of mills upon its banks has gone steadily forward until there are at present 14 large water-wheels supplied with water. Work is now in progress on the enlargement of the canal to about double its original capacity, which when completed will increase the available power to about 20,000 HP. The head of water available is from 90 to 100 ft. As the total fall from the still water above the rapids to the river at the base of the falls is 216 ft., it will be seen that only a portion of the possible power is utilized by the mills along the hydraulic canal. Of course it is impossible to use the entire fall of 216 ft., but it has been long realized that by the construction of a tail-race tunnel for the waste water, having its outlet below the falls, a far greater proportion of the possible head could be made available for use. The engineering difficulties and the great expense involved in constructing such a tunnel, coupled with the difficulty of securing wheels capable of operating successfully under heads of water of much over 100 ft., and with doubts as to the possibilities of transmitting the power economically, have, however, prevented such a work taking practical form until about four years ago.

In 1890 the Niagara Power Co. was formed with a capital stock of $2,000,000, and a few weeks later the Cataract Construction Co. was organized to carry out the necessary work of construction. (Eng. News, May 17, 1890.) It should be noted, however, that the contract for constructing the tunnel had been let the previous fall to Rogers & Clement, of New York. Meanwhile a commission of engineers had been appointed to report on the most feasible plan for generating and transmitting the power. This commission invited and examined plans from a large number of American and foreign firms and finally decided upon the plan which is now being carried out and which will be described here.

To enable a clear understanding of this plan, however, a brief statement of the natural conditions is necessary. The land on the American side of the Niagara River is a quite level plain, through which the river below Buffalo, N. Y,. flows, a comparatively quiet stream, until it reaches a point about a mile above the Falls. From this point there is a gradual descent to the brink of the Falls, where the water takes its leap of 160 ft. into the narrow gorge below. The limited area in the gorge below the Falls, available for the construction of mills and factories, coupled with the great objections which would arise to any construction of a character tending to destroy the natural scenery, makes the plain east of the upper river the only practicable location available. To develop the

FIG. 1. GENERAL VIEW OF CANAL AND POWER HOUSE.

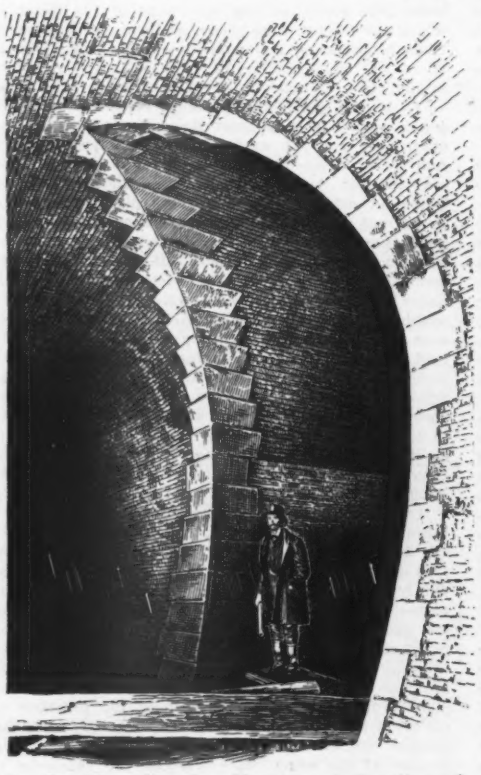


Fig. 5. View Showing Masonry at Junction of Wheel-Pit and Tail-Race Tunnels.

power here it is necessary to excavate deep wheel pits and carry the waste water away by a tail-race tunnel emptying below the Falls. This is practically what is being done.

Briefly stated, the work consists in the construction of a canal with inlets opening into penstocks carrying the water to the turbines in the wheel pit; the excavation of a wheel pit 18 ft. wide and 186 ft. deep in solid rock; the construction of a tail-race tunnel 7,000 ft. long; and the construction and installation of the turbines and machinery for the generation of electric power. As many of the details of the work have been described in former issues of Engineering News* only such features as have not already been given will be described here.

Canal.—The general plan of the canal, wheel pit and tunnel was shown in Engineering News Jan. 23, 1892. As there shown the canal branches off from the river at a point about 1¼ miles above the Falls and runs inland diagonally upstream about 1,500 ft., and thence upstream parallel to the river about one mile, opening again into the river, at a point opposite the lower end of Connor's Island. At present, however, only the lower 1,260 ft. of the canal has been built. This is sufficient to bring the water to the inshore end of the power house, where the three turbines now being installed are located. This portion of the canal is 188 ft. wide at the river and 116 ft. wide at the inshore end, with a depth throughout of 17 ft. The depth of the water will be 12 ft. The sides of the canal are built of solid masonry 7 ft. thick at the bottom and 3 ft. thick at the top. The accompanying photographic view, Fig. 1, will give a very clear idea of the completed portion of the canal and its location in respect to the power house.

In constructing the canal, a horseshoe-shaped cofferdam about 190 ft. long, having its ends on shore and curving out into the river to inclose the mouth of the canal, was first built. This cofferdam was built by sinking two rows of timber cribs 8 ft. apart, filling them with stone and filling the space between with puddle. The cribs were $12 \times 10.4 \times 20$ ft., built of 12×12-in. timbers notched into each other. Floats 12×20 ft. were first moored in the exact position to be occupied by the cribs and accurate soundings taken around their four edges. These soundings enabled the bottom timbers of the cribs to be shaped to conform to the bottom, which was solid rock. The water was from 5 ft. to 8 ft. deep, and had a velocity of about 4 ft. per second.

The excavation for the canal was principally in solid rock, necessitating a complete steam and air compressor plant for operating the drills. The rock was blasted by dynamite; the excavation possessing no features of especial interest. It may be stated, however, that in order to supply water to a large paper mill located on the bank of the canal between the power house and the river, a second cofferdam was built just beyond the inlet to the paper mill, and the water let into the canal up to this point some time before the excavation was completed to the power house. To prevent large

* May 17, May 24, Nov. 8, Nov. 21, 1890; March 14, 1891; Jan. 9, Jan. 23; Dec. 29, 1892; March 30, 1893.

FIG. 3. LONGITUDINAL SECTION OF WHEEL PIT AND POWER HOUSE, SHOWING ARRANGEMENT OF MACHINERY.

FIG. 4. TRANSVERSE SECTION OF WHEEL PIT AND POWER HOUSE.

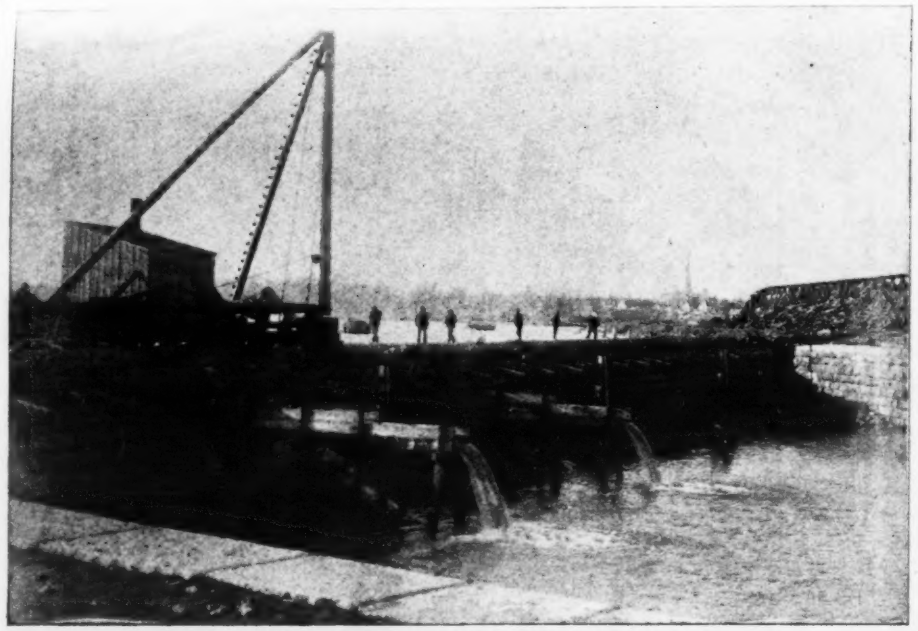


FIG. 2. VIEW OF COFFERDAM AT ENTRANCE OF CANAL.

FIG. 11. PORTAL OF TAIL-RACE TUNNEL.

FIG. 10. VIEW OF TIMBERING IN TUNNEL HEADING.

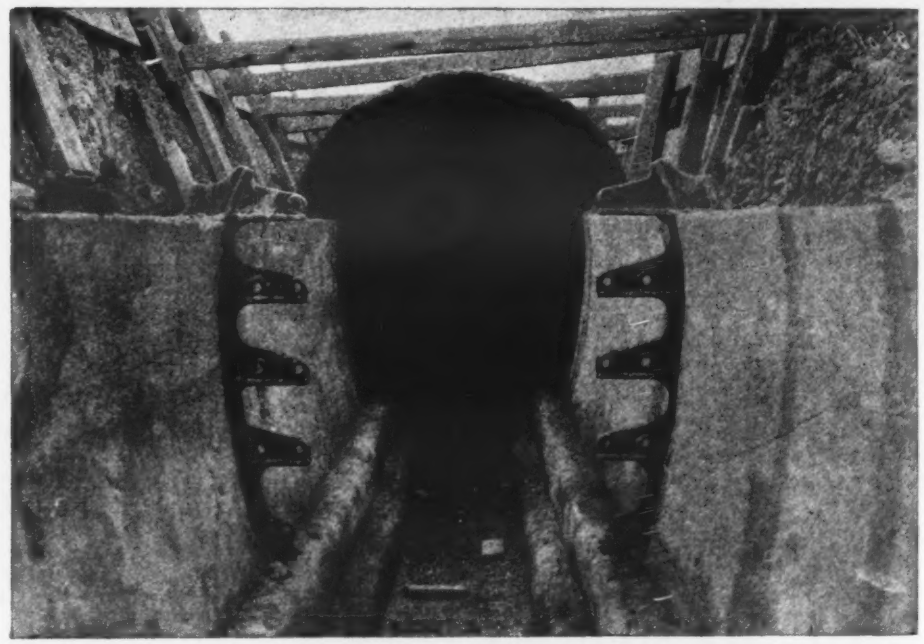


FIG. 12. SUBWAY FOR ELECTRIC WIRES.

THE HYDRAULIC POWER PLANT OF THE NIAGARA POWER CO., NIAGARA FALLS, NEW YORK.

The Cataract Construction Co., Contractors. Geo. D. Burbank, M. Am. Soc. C. E., Chief Engineer.

CHAS. HART & SONS, LITH., 26 VESEY ST., N. Y.

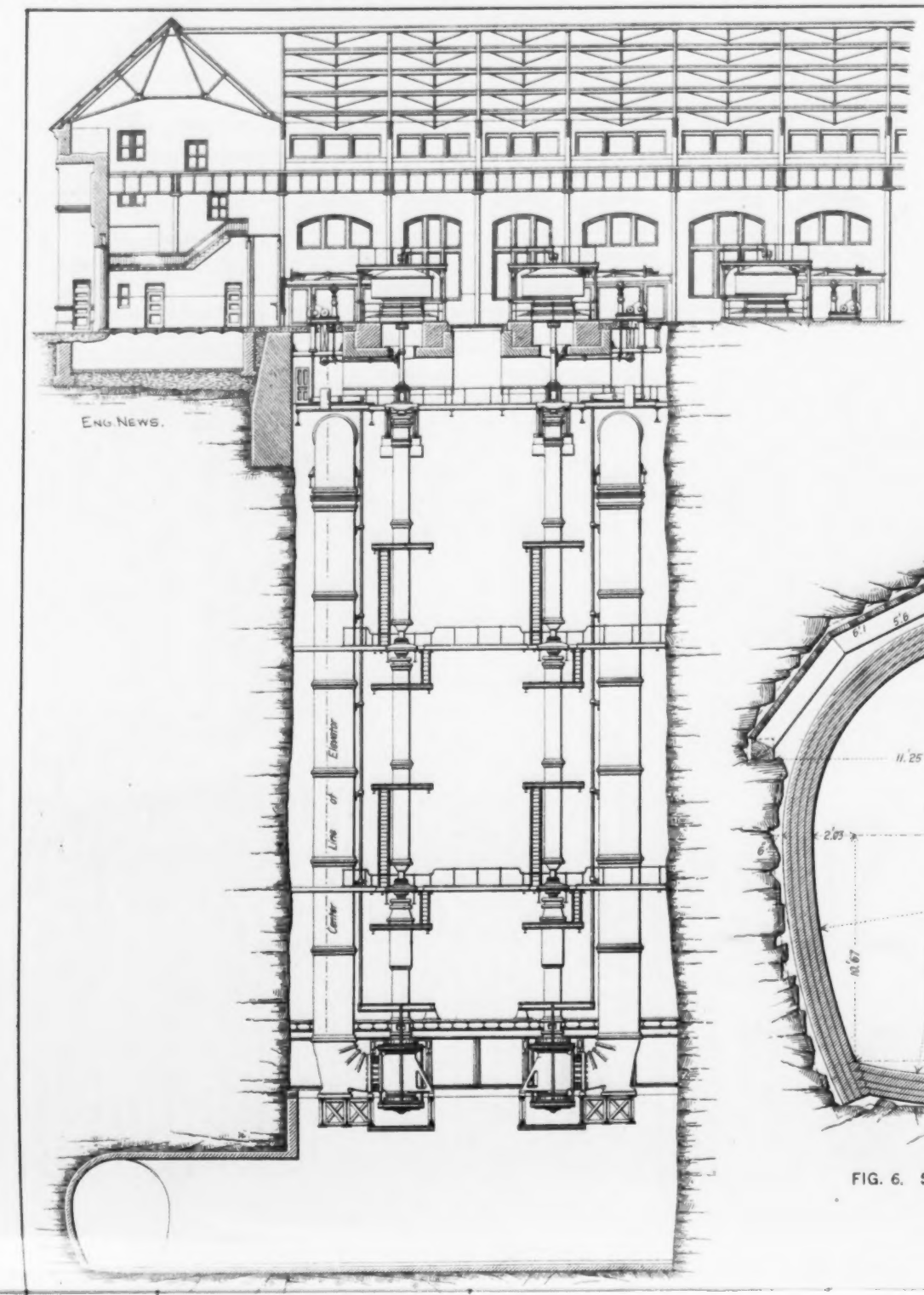


FIG. 3. LONGITUDINAL SECTION OF WHEEL PIT AND POWER HOUSE, SHOWING ARRANGEMENT OF MACHINERY.

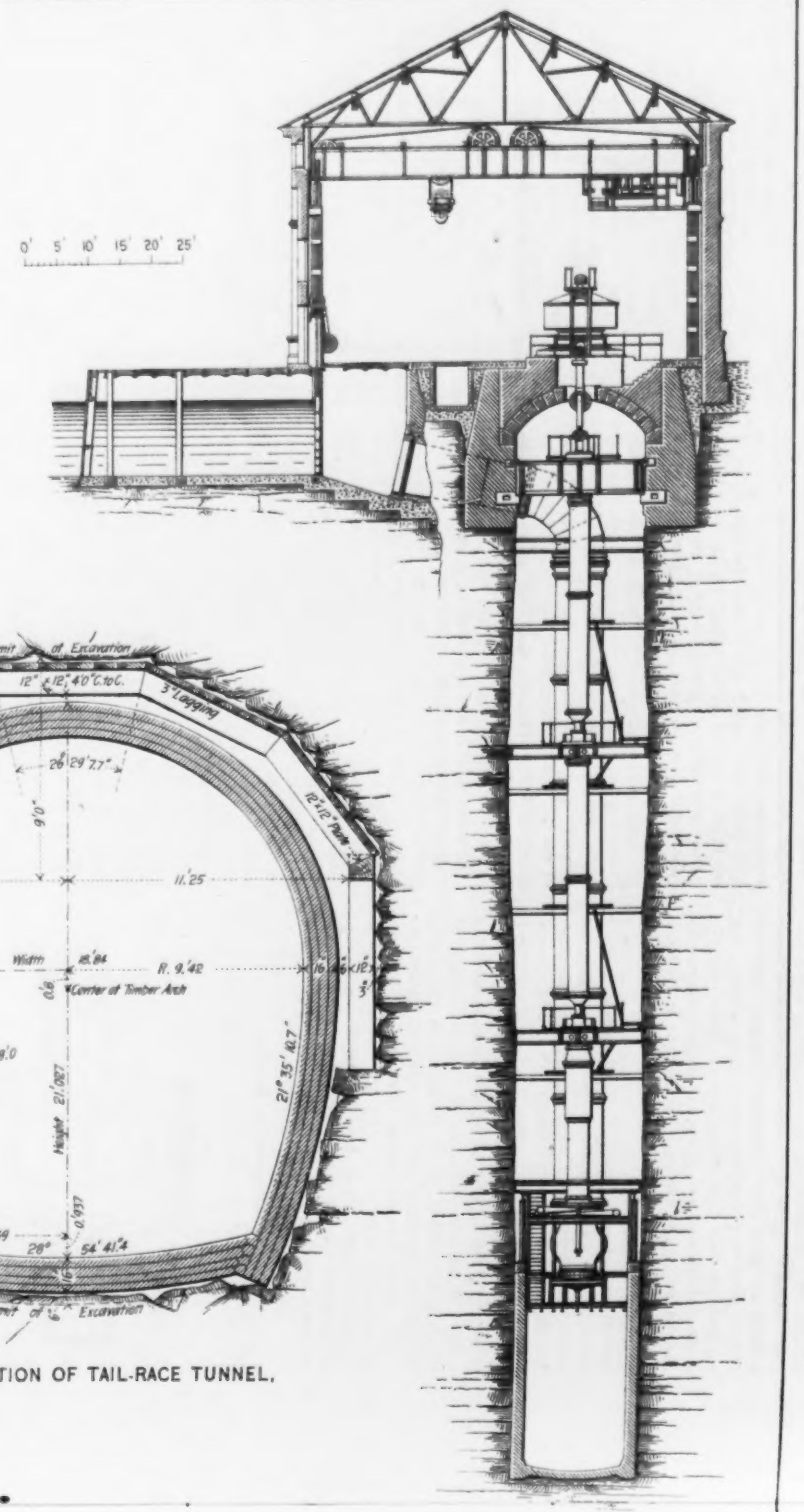


FIG. 4. TRANSVERSE SECTION OF WHEEL PIT AND POWER HOUSE.

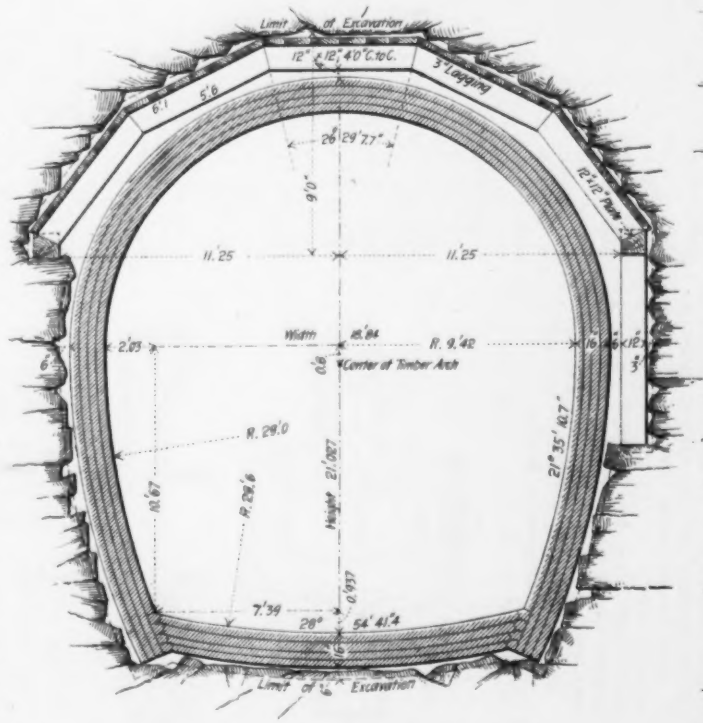


FIG. 6. SECTION OF TAIL-RACE TUNNEL.

floes of ice from entering the canal, a strong boom attached to piers of steel railway rails was built across the mouth of the canal. These piers are shown in Fig. 2, which also shows the construction of the cofferdam and the method of letting the water into the canal.

The water is admitted to the penstocks by inlet channels of masonry in the side walls of the canal. These channels are shown in Fig. 1 and are 17 ft. deep and 14 ft. wide. Ten of them will supply the ten turbines in the main power house and others are provided for future use. Weeds, grass and other floating matter that might pass into the turbines and obstruct them are prevented from entering the inlet channels by iron racks located at the mouth of each. The gates controlling the entrance of water to the penstocks are of steel, moving in cast iron guides and resting against sets of loose rollers which permit easy movement under the enormous pressure of the water, amounting to 75 tons each. It should be stated here, however, that these gates only serve to shut off the water from a penstock when it is not in use. The actual regulation of the speed of the turbines is effected at the turbines themselves by balanced gates which control the water escaping from them, and not by regulating the water admitted to them. This governing mechanism was described in Engineering News, March 30, 1893.

Power House and Wheel Pit.—The general appearance of the main power house is quite clearly indicated in Fig. 1. It is built of stone with a slate roof and enameled brick walls inside. It will be noticed that the end wall shown in the illustration is made of boards. These will be torn out when it is necessary to extend the wheel pit o instal additional turbines and the building will then be extended to cover the machinery. Inside the power house will be the dyna nos and the switchboard

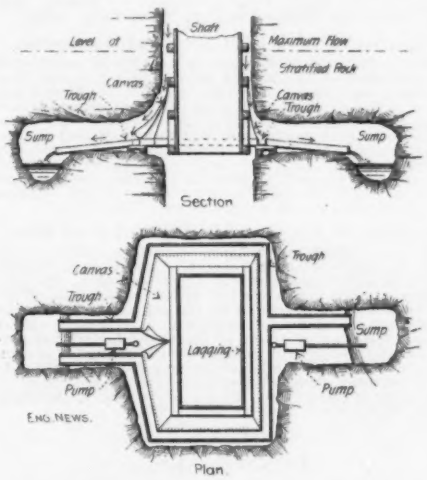


Fig. 7. Sketch Showing Manner of Collecting Seepage Water in Shaft 2.

for generating and distributing the electric power, the resistance coils, transformers, etc., the 50-ton electric traveling crane, and machinery for operat ing the sluice gates.

The wheel pits are simply deep narrow pits excavated in the solid rock, and running lengthwise of the power house. A longitudinal and transverse section of the portion of the pit now completed are shown in Figs. 3 and 4. These illustrations are from the last revised drawings, never before published, and show the arrangement of all the machinery as it is being constructed. One end of the wheel pit connects by a short tunnel with the raceway tunnel. The masonry at the connection of the two tunnels is shown in Fig. 5, reproduced from a flashlight photograph.

Tunnel.—The construction of the raceway tunnel was begun in the fall of 1890, Rogers & Clement being the contractors. The excavation was through a limestone rock with slaty seams. This rock appeared hard and compact when first exposed, but seemed to slack upon exposure and fell, often in large masses. This of course necessitated timbering the roof, as shown in the cut (Fig. 6) and afterward constructing a brick masonry lining.

Three shafts were sunk, one at the portal, one 2,600 ft. from the portal and one 5,200 ft. from the portal leaving 1,800 ft. to reach the wheel pit. The portal, leaving 1,800 ft. to reach the wheel pit. The merely in blasting away a portion of the face of the cliff and constructing the masonry staging for hoisting the spoil to the top of the cliff. Shafts 1 and 2 were sunk in solid rock and were 260 ft. and 196 ft. deep, respectively. Each shaft was sunk

Fig 8. Sketch Showing Arrangement of Heading and Benches in Driving Tail-Race Tunnel.

independently and had its own steam plant, but the main part of the excavation was done from shaft 2, so that the plant here was much larger than at the other shafts. The character of the plant used at each shaft was described in Engineering News, Jan. 9, 1892.

Aside from the water, which gave serious trouble, the sinking of the shafts was not unusually difficult. The maximum flow in shaft 1 was found at a depth of 105 ft. and in shaft 2 at a depth of about 70 ft.; the amounts of flow being 800 and 600 gallons per minute, respectively. The manner of collecting and removing this water is roughly shown in the sketch Fig. 7. As will be seen, two drifts were made on opposite sides of the shaft about 15 ft. below the point of maximum flow. A canvas trough, if it may be so called, was attached to the tunnel timbers, as shown in the sketch, which served to deflect the seepage water into the wooden troughs and thence into the sumps, from which it was pumped. Holes were also driven vertically upward in the roofs of the drifts to stop such water veins as were of large size.

Headings were driven in both directions from each shaft except, of course, the portal shaft, making in all five headings. A heading the full width of the tunnel was first driven and the remainder of the rock removed in two benches as diagrammatically shown in the sketch Fig. 8. The headings were driven by the center-cut system, from four to six drills being used. Dynamite was the explosive used, and the air escaping from the drills served to efficiently ventilate the tunnel. In general the tunnel was very dry.

The method of timbering the tunnel as work progressed is shown in Fig. 9, and also by the photographic view Fig. 10. As the heading was excavated the two sills A A were laid, and the rib timbers B B erected and braced by the struts C C. As the second bench was removed the sills were supported by the posts D D in case the rock broke so as to leave a ledge, otherwise by the batter posts E E. The brick masonry was then put in, about 13,000,000 bricks and 45,000 bbls. of Giant Portland cement being used. The composition of the mortar was one part cement and three parts sand. The largest number of bricklayers at work at one time was 75, and with 130 helpers they would lay about 110,000 bricks in ten hours. A view of the river portal of the tunnel is shown in Fig. 11. The total time consumed in building the tunnel was 23 months.

Power-Generating Machinery.—Returning now to the machinery in the wheel pit; the turbines have already been illustrated and described in detail in Engineering News of March 30, 1893. Some of the general features may, however, be briefly reviewed. The commission of engineers before noted, after careful study, decided to divide the power generated into units of 5,000 HP. The turbines for each unit are made in pairs on one vertical shaft and the water enters the wheel case between the two turbines from a vertical penstock 7½ ft. in diameter. The amount of water required for each turbine is about 25,000 cu. ft. per minute. The shaft upon which the wheels are carried is of solid steel and from 11 ins. to 12 ins. in diameter at the bearings, and a weldless rolled steel tube between bearings. The fields of the dynamos are fixed to the top of this shaft and revolve with it. As will be seen the problem was very like what it would be in designing the shaft of a steamship, except that in this case the shaft is vertical instead of horizontal, and the downward thrust of its weight and that of the revolving field of the dynamos upon the bearings had to be provided for. This was done by so constructing the upper turbine and wheel case that the upward pressure of the water head balances the weight. This feature of the construction and the construction and operation of the governors for regulating the speed of the turbines were fully illustrated in the article last referred to and will not be further described here.

Dynamos.—After a thorough study of the conditions under which electric power was to be generated and the purposes for which it was to be used, it was decided to adopt a low frequency alternating current generated in two phases and at a pressure of about 2,000 volts as the best adapted to all the conditions. Transformers are to be used for increasing or decreasing the pressure and separate motor generators are to be used for obtaining a continuous current.

With the above general features decided upon, the design of a suitable dynamo was the problem first at hand. A large number of American and foreign manufacturers were asked to submit plans and some 24 different designs were received. None of these were selected, however, and in May, 1893, Prof. George Forbes, of England, was instructed to prepare plans for a 5,000 HP. alternator. In a recent paper read before the London Institution of Electrical Engineers, Professor Forbes describes the construction of his alternator as follows:

On the bed-plate a vertical cylinder is bolted, with projections to support the fixed armature and the bearings of the revolving part. The armature coils are wound independently and can be removed and changed. They are fixed in slots in the fixed armature, and encased in an oil-tight casing through which oil can be circulated. The field magnet is external to the armature, and has the poles pointing radially inwards. It consists preferably of forged steel supported by a spider with eight arms, which may be of steel with a covering of thin sheet metal, on which cups are provided for forcing air into the interior of the ma-

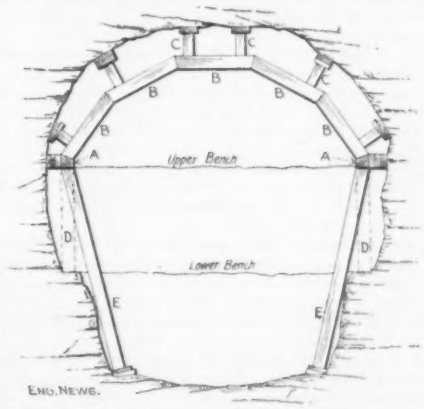


Fig. 9. Sketch Showing Method of Timbering

chine. The pole-pieces are bolted to the steel rim. The field coils are of copper strip, two coils being wound upon each pole, with a space between them for air circulation. The exciting current is applied by rings of tempered copper on the spider, having fixed brushes rubbing on them. The hub of the spider is firmly fixed to the upper end of the shaft. The spider supports the heavy rim by 16 studs and nuts. The shaft is supported by two bearings, each of which has four radial arms, which are bolted to four corresponding projections on the cast iron cylinder. This cast iron cylinder is bolted to the bed-plate, and adjusted thereon by wedges. Besides having on it the projections for carrying the bearings on its inner side, it has on its outer periphery a series of vertical ribs against which the stampings, or sheets of iron forming the armature, rest.

The cylinder also supports the lower end plate on which the armature is built up, and the armature is keyed to it by a single key. The armature is wound drum fashion—that is, all on the outside. This enables the coils to be wound independently and laid in their places, and also to be easily replaced in case of accident. In order to do this satisfactorily, the slots for each coil in the iron are cut, not radially, but parallel to each other. Each coil is encased in insulating material, which forms a tube through which oil may flow

as in a transformer, but may be forced, in which case its circulation is maintained by a pump. Round the base of the machine there are two oil pipes, one being the inlet, the other the outlet. The inlet pipe is connected with a reservoir of oil in the power house. The outlet pipe leads by another pipe to cooling arrangements in running water, from which the oil is pumped to the reservoir. From the inlet pipe 16 brass tubes are led from the junction boxes at the top of the coils through the interior of the fixed armature and bent over the foundation plate, and so connected to the outlet pipe which surrounds the bed-plate. The armature is built up of thin sheet iron, with ventilating spaces. The bolts which hold the armature together are eight in number, to be made of nickel-steel, a metal which has the great advantage of being non-magnetic and of very high electrical resistance and great mechanical strength. The amount of nickel is 25%.

There are 16 armature coils, eight being of one kind, called "short" coils, and eight of another kind, called "long" coils, the length of wire on each coil being the same. The short coils are bent over at the end plate, and the long coils are wound in one plane, and inclose the short coils. The layers of wire in the coils are separated by mica. Each coil when wound has strips of insulating material laid spirally around it, so that oil may circulate freely in the interva's, and the whole is inclosed in a casing of strong insulating material, preferably woodite, ⅛ in. of which will not break down with 30,000 volts, and which is not acted upon by oil even at high temperatures.

The frames of the bearings are of cast iron, with four radial arms, which rest upon four projections cast on the vertical cylinder, and are bolted to them. By this means, when the field magnets with the shaft have been lifted out of place, the bearings can be twisted through an angle of 45° in a horizontal plane and then raised out of place, leaving a space of 5 ft. in diameter through which portions of the turbine shaft can be raised for repair. The bearings are oiled at the center by oil forced under pressure through a pipe. The oil is then distributed over the bearings by spiral grooves. A spiral groove is also cut in the hub of the frame, with a pipe at each end to admit of water circulation to cool the bushing. At two opposite sides of each bearing the bushing is made thin, and a rod of bismuth is soldered thereto; so that if the bushing is heated, a thermo-electric current shall be created which, by means of a relay, can ring a bell in the power house. When this occurs, water can be immediately admitted to cool the bearings, and the attention of the workmen drawn to the necessity of an examination.

One of the parts which required most consideration was the material of which the spider supporting the field magnets should be constructed. The best plan is to make it of steel, for the sake of lightness, and to cover it with a copper covering, which might, I think, be spun; or, perhaps better, electro-deposited nickel might be used. Between the two pole-pieces the space is filled up with a screen or plate of metal so as to direct the air ventilation only upon the parts which most require cooling.

It will be obvious from this design, considering that the speed of revolution is 250 per minute, that great care has to be devoted to the balancing of the revolving parts; everything has to be calculated not only for a speed of 250 revolutions, but for double that amount, which is the maximum speed at which the turbines could possibly run—at which speed they might run through a break down of the governor, although this is an accident almost impossible to occur. Each of the revolving parts will of course be balanced individually, and I have suggested a plan for the final balancing which seems likely to be effective. A temporary bushing would be put in the bearings, of india-rubber lined by a thin metal tube. The dynamo would then be rotated slowly and the balance adjusted in the usual way. The speed of revolution would be gradually increased, a new adjustment being made at each speed, until a speed of 500 revolutions a minute is attained, and when an adjustment has been made at this speed it is pretty sure that the balance of 250 revolutions per minute will be very perfect, and the mechanical friction reduced to a minimum.

Line Construction.—For the first 2,500 ft. the wires for conveying the current will be placed in a concrete subway 5½ ft. high and sufficiently wide to allow of the passage of an inspection car. The general form of this subway is shown in Fig. 11. The wires are carried on the iron brackets at each side and wood and wire screens separate them electrically and mechanically from the central portion where the inspection car runs. It is not fully decided yet in what way the wires will be carried beyond this 2,500 ft., but it is possible that the subway may be extended to Buffalo, N. Y. Copper strip conductors will probably be used.

In discussing the size and efficiency of the conductors Professor Forbes says:

With regard to the size of conductors, I worked out the economical size at different current densities for the whole distance, using the following data: I took the cost of copper at 12½ cts. per lb., and the annual charge on this cost at 5%. I then computed the power loss in the line, and the amount of power which was left available for delivery. I took the value of this power at the distant end of the line as being $15 per HP. From this it appears that the most economical density to work at is 350 amperes per sq. in. If this density is used, the fall in volts between Niagara Falls and the northern boundary of Buffalo is only 3½%, a matter which makes regulation extremely easy.

With regard to the efficiency of the system, it is remarkable how high the efficiency of the dynamos comes out when we are dealing with the large units of 5,000 HP. There can be but little doubt that the efficiency, electrical and mechanical, of our dynamos may reach at least 98%. Taking off 3½% for losses on the line, we would have 94½% delivered electrically at Buffalo if no transformers were required to raise the electric pressure to the full 20,000 volts. In cases at Buffalo where the power consumed is very large, the motor can be constructed on the same principles as the dynamo; and if in case it be ever possible to work at the full pressure without a transformer, it is obvious that the total efficiency of the system—that is, the power delivered by the motor to the shaft of the machinery, divided by the power delivered by the shaft of the turbines to the dynamo, will be certainly over 90%. As a matter of fact, if we were to use a higher density of current, and were to use step-up transformers at Niagara Falls and step-down transformers at the northern boundary of Buffalo, and other step-down transformers in the town of Buffalo itself, and were to use motors of small power, and consequently of less efficiency—in this case the total efficiency of the plant might be reduced to 80%, or even lower.

In the foregoing we have attempted to describe only that portion of the work which has actually been constructed or definitely decided upon. In closing, however, a few of the general features of the future development may be touched upon. The Niagara Power Co. at present owns a tract of about 1,500 acres of land in the vicinity of its proposed canal. This land is to be divided into sites for the erection of manufacturing plants of all kinds, which may either take their power from the company's power station or may erect their own turbines and receive water from the company's canal. At present the mills of the Niagara Falls Paper Co. are operating three 1,100 HP. turbines from the canal. A portion of the land is also to be devoted to the erection of houses for the employees of the different manufactories, the Land Development Co. having been organized to carry out the necessary work of constructing the dwelling houses and providing for sewerage, water supply, and other necessary improvements. To provide railway facilities to the various factories the Niagara Junction Ry. Co. has been organized and has constructed six miles of terminal lines connecting with the various roads entering the town.

The principal use of the electric power developed at first will be for electric light and railway purposes and for the production of aluminum by the Pittsburg Reduction Co., which is now erecting an extensive plant in the vicinity of the main power station, and perhaps for propelling the boats on the Erie Canal, should electricity ever be adopted for that purpose. For all these purposes, except electric lighting, a continuous current is necessary. Among the various manufactories which the near future is likely to see established are a number of wood and pulp mills. As these mills usually work continuously day and night without stopping, it is thought that power can be supplied to them by synchronizing alternators very efficiently and economically. The great variety of other uses possible, in machine shops, and for running elevators, cranes, etc., will be readily seen.

The whole work of construction has been carried out by the Cataract Construction Co., for the Niagara Power Co., which will operate the plant when completed. The sub-contractors for the different portions of the work were Rogers & Clement, of New York, N. Y., for 6,700 ft. of the masonry tunnel; Douglas & Johnson, of Niagara Falls, N. Y., for the canal, wheel pit and 300 ft. of the tunnel; James Stewart & Co., of St. Louis, Mo., for the power house, and the Pennsylvania Steel Co., for the structural iron work. The machinery in the wheel pit was manufactured by I. P. Morris & Co., of Philadelphia, Pa. Dr. Coleman Sellers, M. Am. Soc. C. E., is the Consulting Engineer. We are indebted to the Cataract Construction Co., through its late Chief Engineer, Geo. D. Burbank, M. Am. Soc. C. E., and Resident Engineer John G. Tait, for the matter from which our illustrations and the above description have been prepared.

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Boundaries of Municipality.

Where a navigable stream is declared by statute to be one of the boundaries of a municipality, the low-water line, and not the thread of the stream, is the boundary. In North Carolina the test of navigability of a stream is not whether the stream is subject to the ebb and flow of the tides, but whether it is navigable for seagoing vessels.—State v. Eason (Sup. Ct. of N. C., 19 S. E. Rep., 88).

Validity of Declarations of Deceased Surveyor.

Where a survey made by a deceased surveyor calls for the east line of another survey as one of the boundaries of the tract surveyed, other surveys made by the same surveyor at about the same time, and locating such east line, are admissible as declarations to show where such line is located, whether such other surveys are legal or not.—Cottingham v. Seward (Ct. of Civil Appeals of Tex., 25 S. W. Rep., 797).

Effect of Statutory Limitation of Bonded Debt.

The Supreme Court of Michigan, decides that where a city empowered to buy from the waterworks company operating therein all its pipe laid in streets, stock, and franchises, and provide for payment by bonding except that its total debt for borrowed money shall not exceed 5% of the assessed valuation of property therein cannot buy the company's equity of redemption from a bonded debt which, as a debt of the city, would be excessive.—Ironwood Water-Works Co. v. Trebilock (57 N. W. Rep., 371).

Statute of Limitations as to Right to Open Street.

The statutes provide that every public highway laid out and dedicated to the use of the public, that shall not have been opened and worked within six years from the time of its being laid out, shall cease to be a road for any purpose whatever. Where a street in which the city has acquired only an easement, and not the fee, is laid out entirely, but worked and opened only in part, the public loses its right therein after the lapse of six years.—City of Buffalo v. Hofield (Sup. Ct. of Buffalo, Equity Term, 27 N. Y. Supp., 868).

Conflict Between Field Notes and Monuments.

While the corners of a survey as actually established and marked on the ground by the United States Government surveyors control the designation of such corners in the plats or field notes, yet the presumption is that the corners have been established at the places indicated by such field notes; and the proof that the actual establishment was different must be clear and convincing, where the actual location as claimed does not accord with the section lines in adjoining sections, and will establish the claim in an irregular shape.—Cadeau v. Elliott (Sup. Ct. of Wash., 34 Pac. Rep., 916).

Damages to Abutters for Obstruction of Street.

If the roadbed and railway track of a railway company is completed upon a street of a city of the second class in accordance with the provisions of a city ordinance, or with the assent and under the direction of the city officials and is treated by the railway company, the city officials and the lot owners as a permanent taking or appropriation of a part of the street for railway purposes, and thereby the access to an abutting lot is completely obstructed, the lot owner may recover of the railway company damages for consequent depreciation in the value of the lot.—A., T. & S. F. R. Co. v. Davidson (Sup. Ct. of Kan., 35 Pac. Rep., 787.)

PERSONALS.

Mr. N. C. Naylor has been elected City Engineer of Moscow, Fla.

Mr. Jesse H. Farley, one of the early railway contractors of the West, died in Dubuque, Ia., May 8, at the age of 81.

Mr. William S. Dawley has been appointed Chief Engineer of the Chicago & Eastern Illinois Ry., vice Mr. H. F. Baldwin, resigned.

Mr. R. E. Ricker, formerly General Superintendent of the St. Louis, Iron Mountain & Southern Ry. and Denver & Rio Grande Ry., died at Weeping Water, Neb., May 17.

Mr. J. J. McVean, M. Am. Soc. C. E., has been appointed a member of the Board of Public Works of Grand Rapids, Mich. He is Chief Engineer of the Detroit, Lansing & Northern Ry. and the Chicago & West Michigan Ry.

Prof. H. S Williams has been appointed Professor of Geology and Mineralogy at Yale University, vice Professor Dana, resigned. He went to Yale two years ago from Cornell. He was graduated from the Sheffield Scientific School in 1868.

Mr. A. H. Porter, Assoc. Mem. Am. Soc. C. E., has been appointed City Engineer of Niagara Falls, N. Y. He is a member of the firm of Johnson & Porter, civil engineers, by which plans have been prepared for the new power section of the Buffalo & Niagara Falls Electric Light & Power Co.

Prof. James D. Dana, who has held the professorship of geology and mineralogy at Yale University for 44

years, has resigned, and has been elected professor emeritus by the corporation. He was born in Utica, N. Y., in 1813, and graduated from Yale in 1833. He was then appointed instructor of mathematics to midshipmen in the U. S. Navy, and visited the Mediterranean in 1836. He was assistant in chemistry to Professor Silliman. He took part in the Wilkes exploring expedition during 1838-'42 as geologist, and made a special study of the corals and crustacea of the South Seas. During the 13 years that followed he was occupied principally in preparing his reports for publication by the government. He was appointed Silliman professor of natural history and geology at Yale in 1850, the title of the professorship being changed to that of geology and mineralogy in 1851. He became associate editor of "The Americal Journal of Science and Arts," and on the death of Professor Silliman, its senior editor. His contributions to this and other scientific magazines number hundreds. His principal works in book form are "System of Mineralogy," "Coral Reefs and Islands," "Manual of Geology," "Textbook of Geology," "The Four Rocks," and "Walks and Drives About New Haven." His last published works are "Volcanoes," and a second edition of the "Coral Islands."

NEW PUBLICATIONS.

THE POLLUTION OF THE PAWTUXET RIVER: Report of the State Commission Made to the General Assembly of Rhode Island at its January Session, 1894. Samuel M. Gray, M. Am. Soc. C. E., Providence, R. I., Engineer to the Commission. 8vo; paper; pp. 43.

Action early in 1892 on the part of the city of Providence to secure ample power from the state legislature to prevent the pollution of the Pawtuxet River, from which it draws its water supply, resulted in the appointment of a commission of three to investigate the matter. This commission set out to ascertain the feasibility of constructing a sewer through the valley of the Pawtuxet to intercept polluting matter or to find other means of securing pure water at the pumping station intake of the Providence water-works. Nearly two years have elapsed since the commission was appointed, and its report has just been made public. Some of the delay, perhaps much of it, has been caused by the failure of the legislature to appropriate the necessary funds, on which account the work came to a standstill about a year ago. The commission recommends that water be taken from one or the other of the two branches of the Pawtuxet River, above the sources of pollution. Mr. Samuel M. Gray, M. Am. Soc. C. E., was appointed engineer to the commission and presents in the report a discussion and estimates of the cost of constructing the proposed sewer and of securing a supply from the headwaters of the river.

For the benefit of any who may be interested in the possible adoption of the recommendations of the commission and the construction of new supply works by the city of Providence, it may be added that it seems very probable that the city will purify the supply from the old source rather than adopt the recommended new source for the present.

DRAINAGE CHANNEL AND WATERWAY: A History of the Effort to Secure an Effective and Harmless Method for the Disposal of the Sewage of the City of Chicago, and to Create a Navigable Channel Between Lake Michigan and the Mississippi River. By G. P. Brown. Chicago, 1894: R. R. Donnelly & Sons Co. 8vo; pp. 480; illustrations, 19.

The sub-title given above indicates pretty clearly the character and scope of this volume, which has been prepared by the authority of the Board of Trustees of the Sanitary District of Chicago. The first seven chapters discuss briefly and quite superficially the questions of water supply and sewage disposal for large cities and trace succinctly the development of the water-works and sewerage systems of Chicago, and especially the various efforts to dispose of the sewage previous to the completion of the Illinois and Mississippi Canal in 1848. The remaining 24 chapters give at some length the history of the effort to secure the construction of the Illinois and Mississippi Canal; its use and subsequent deepening to provide for the disposal of the sewage charged waters of the Chicago River, and finally the development and consummation of the plan for the drainage canal as the inadequacy of the old canal for purifying the river became apparent. The work is largely historical and gives little except in a very general way regarding the extent, character and prosecution of the work on the drainage canal proper. As a general rule the author has shown discretion in quoting from official reports and documents, and the book is remarkably free from the verbiage which usually characterizes publications of an official nature.

THEORY AND PRACTICE OF THE TEETH OF GEARS. By George B. Grant, Lexington, Mass., Lexington Gear Works. 8vo; pp. 106; illustrated.

This is a complete treatise on the subject of gears, dealing with various forms of teeth and their design and development. Pin tooth gears and twisted, spiral, bevel and worm gears, etc., are also discussed. The book is well printed and profusely illustrated.

TRADE PUBLICATIONS.

CATALOGUE OF ENGINEERING, SURVEYING AND SCIENTIFIC INSTRUMENTS. Lahn & Co., St. Louis, Mo. 12mo; cloth; pp. 48; illustrations, 12.

This catalogue contains the usual description and illustrations of standard transits, theodolites, levels, etc., and also describes briefly some of the special instruments manufactured by the company. The more notable of these special instruments are Prof. J. B. Johnson's extensiometer for measuring the distortion of test pieces of metals, and Mr. B. H. Colby's protractor especially designed for plotting angles and distances by polar co-ordinates, as taken by the ordinary method of stadia surveying.

ROOFS AND BUILDINGS.—Shiffler Bridge Co., Pittsburg, Pa. Cloth; 4to; pp. 137; illustrated.

There is an increasing tendency toward the use of half-tone illustrations in catalogues, and this "album of designs" from the building department of this well-known company consists almost entirely of such views of factory roofs and buildings, trainsheds, car barns, etc. The plate is on one page, and on the opposite page is a brief description giving the size and special features of the design. The book is handsomely printed on plate paper, and contains a general description of the company's works.

SURVEYING AND ENGINEERING INSTRUMENTS. —W. & L. E. Gurley, Troy, N. Y. 8vo; pp. 66; illustrated.

This is a complete and handsome catalogue of instruments of all kinds, plummet lamps, current meters, rods, etc., and is profusely illustrated with views of the instruments and of the workshops in which they are manufactured.

ROAD ROLLERS. O. S. Kelly Co., Springfield, O. 4to; pp. 12 and 16; illustrated.

One of these pamphlets contains descriptions of the road roller and asphalt roller, together with an article on "Our Common Roads," and the other contains particulars of road construction and repairs, with excellent half-tone illustrations.

AIR COMPRESSORS.—Clayton Air Compressor Works, New York; 4to; pp. 8.

This is a special catalogue of single and duplex air compressors for operating pneumatic calking tools, riveters, and other tools. Speed governors for steam and belt power compressors are also shown.

MOLDING MACHINES. Tabor Mfg. Co., New York, N. Y. 8vo; pp. 15; illustrated.

This company's machines for making sand molds for metal castings are extensively used in a number of foundries. The sand is compressed in the flask by a ramming head operated by steam.

RAILWAY EQUIPMENT. A. S. Males & Co., Cincinnati, O. 12mo; pp. 47; illustrated.

This is a catalogue of second-hand standard and narrow-gage locomotives of various types and sizes, passenger cars, private cars, freight cars, steam shovels, turn-tables, etc.

SOCIETY PROCEEDINGS.

LIVERPOOL ENGINEERING SOCIETY.—The annual meeting was held May 2. Prof. H. S. Hele-Shaw, of University College, Liverpool, was elected President for the next session. The discussion was concluded on the paper on Distribution of Water Supplies, by Mr. Thos Duncannon.

SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.—At the meeting of April 27, a paper on Monier Construction was read by the President, Mr. E. Lee Heidenreich. Particular attention was paid to the working of the system in actual practice. (The principal points brought out have already been given in Engineering News of May 23, 1891, and Feb. 16, 1893.—Ed.) Howard Berge, Secy.

ENGINEERS' CLUB OF ST. LOUIS.—At the meeting on May 16, Mr. T. L. Condron read a paper on "Punching as a Means of Testing Structural Steel," presenting the results of nearly 600 punching tests made at the Washington University testing laboratory. Mr. Condron made earlier studies of this subject at Pittsburg and Terre Haute, and was assisted in his investigations by Prof. J. B. Johnson and Messrs. Harrington and Norton, students of Washington University. A paper by Mr. David Molitor on "The Distortion of a Framed Structure Graphically Treated," was read by title. Wm. H. Bryan, Secy.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—The twenty-sixth annual convention will be held at the Cataract House, Niagara Falls, N. Y., beginning at 10 a. m., on Wednesday, June 20. The final session will be held on Monday, June 25. Arrangements for the convention have been in the hands of a committee of the Board of Direction for some time past, and a local committee of arrangements has been appointed by the president. Arrangements have been made to visit the works of the Niagara Power Co., which is now developing the water power of Niagara Falls, including the power-house, turbines of 5,000 HP. each, wheel-pits, tunnels, industrial village, sewerage disposal works, etc. The mill of the Niagara Paper Co., which is the largest existing single paper mill, and is now using 3,300 HP., and the mills supplied by the Niagara hydraulic canal, will also be visited, and visits to other points of interest will be arranged. Business meetings will be held, at which important amendments to the constitution will be considered, reports received and discussed, a committee elected for the nomination of officers for the ensuing year, and general business transacted. A reception will be held on one evening. The proposed amendments to the constitution are partly corrections of certain ambiguities in the present wording, among which we note with especial pleasure an amendment to the clause referring to the indorsers of a candidate for admission to the society, which we criticised editorially in our issue of Jan. 25. The actual changes proposed are (1) to abolish the membership grade of "Subscribers," a grade which has existed only in the constitution; (2) to have the secretary elected by the Board of Direction, instead of by general vote of the society, a most commendable change, which was also urged in our issue of Jan. 25; (3) to wipe out the present system of making nominations and constitute the Board of Direction (excepting the secretary and treasurer) a nominating committee according to the following plan:

The Board of Direction shall hold a meeting between the 1st and 10th of October in each year, at which it shall resolve itself into a committee for the nomination of officers to be balloted for at the next general election. A quorum of such committee shall consist of seven members of the board, exclusive of the treasurer and secretary, neither of whom shall have a seat or vote on the committee. The nominations for the offices to be filled shall be so made as to distribute them geographically throughout the United States and Canada, under a method to be regulated from time to time by the Board of Direction; provided that including the officers holding over, there shall always be a resident vice-president and six resident directors. The nominees shall be immediately advised by the secretary, and if any one or more of them decline the nomination, or prove from any cause ineligible, the Board of Direction shall select substitutes. The list of the nominees shall be mailed to all corporate members not later than Oct. 31.

COMING TECHNICAL MEETINGS.

ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
June 1. Secy., E. K. Smoot, 803 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
June 1. Secy., O. Von Geldern, 719 Market St., San Francisco.
ENGINEERS' CLUB OF PHILADELPHIA.
June 2. Secy., L. F. Rondinella, 1122 Girard St.
SWEDISH ENGINEERS' CLUB.
June 2. Secy., P. Valentine. At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 106 Randolph St., Chicago. Secy., C. T. Anderson.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
June 5, 8. Convention at Montreal, Can. Secy., F. R. Hutton, 12 W. 31st St., New York City.
WESTERN SOCIETY OF ENGINEERS.
June 6. Secy., Thos. Appleton, Lakeside Bldg., Chicago.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
June 6. Annual meeting at Niagara Falls, June 20. Secy., F. Collingwood, 127 E. 23d St., New York.
ENGINEERS' CLUB OF ST. LOUIS.
June 6. Secy., Wm. H. Bryan, Turner Bldg.
MONTANA SOCIETY OF CIVIL ENGINEERS.
June 9. Secy., G. O. Foss, Helena.
ENGINEERS' CLUB OF KANSAS CITY.
June 11. Secy., Waterman Stone, Baird Building.
WISCONSIN POLYTECHNIC SOCIETY.
June 11. Secy., M. F. Schinke, City Hall, Milwaukee.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
June 12. Secy., F. C. Osborn, Case Library Building.
NORTHWEST RAILWAY CLUB.
June 12. Secy., W. D. Crosman, Ryan Hotel, St. Paul.
NORTHWESTERN SOCIETY OF ENGINEERS.
June 12. Secy., D. W. McMorris, Burke Blk., Seattle, Wash.
DENVER SOCIETY OF CIVIL ENGINEERS.
June 12. Secy., F. E. King, Jacobson Block.
MASTER CAR BUILDERS' ASSOCIATION.
June 12, 16. Saratoga, N. Y. Secy., J. W. Cloud, Rookery Building, Chicago.
CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
June 13. Wichita, Kan.
NEW ENGLAND RAILROAD CLUB.
June 13. Secy., F. M. Curtis, P. O. Box 1576, Boston.
ENGINEERING ASSOCIATION OF THE SOUTH.
June 14. Secy., Hunter McDonald, Nashville, Tenn.
ENGINEERS AND ARCHITECTS' CLUB OF LOUISVILLE.
June 14. Secy., G. W. Shaw, Norton Building.
NEW ENGLAND WATER-WORKS ASSOCIATION.
June 14, 16. Annual convention at Boston. Secy., R. C. P. Coggeshall, New Bedford, Mass.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
June 15. Secy., D. W. Meeker, St. Paul.
TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS
June 15. 201 Washington Building.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
June 17. Secy., C. H. McLeod, Montreal, P. Q.
ENGINEERS' CLUB OF MINNEAPOLIS.
June 18. Secy., E. Nexsen, 504 Kasota Block.
MASTER MECHANICS' ASSOCIATION.
June 19, 23. Saratoga, N. Y. Secy., Angus Sinclair, Temple Court, New York.
COLUMBIAN ENGINEERING SOCIETY.
June 19. Secy., F. W. Hart, Washington, D. C.
BOSTON SOCIETY OF CIVIL ENGINEERS.
June 20. Secy., S. E. Tinkham, 36 Bromfield St.
NEW YORK RAILROAD CLUB.
June 21. Secy., John A. Hill, Temple Court.
ENGINEERS' CLUB OF CINCINNATI.
June 21. J. F. Wilson, 24 W. 4th St.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
June 21. Secy., Howard Berge, 100 Washington St.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
June 21. Secy., Daniel Carhart, Carnegie Lib. Bldg., Allegheny.

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York.

Entered at the Post Office, New York, as Second Class Matter.

VOL. XXXI. THURSDAY, MAY 24, 1894.

D. McN. STAUFFER, A. M. WELLINGTON.....EDITORS.
CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER,.....ASSOCIATE EDITORS.
GEO. H. FROST.....BUSINESS MANAGER.
F. P. BURT.....ASSISTANT MANAGER.

CHICAGO OFFICE: 1,636 The Monadnock.

CHAS. S. HILL.....RESIDENT EDITOR.
F. A. PECKHAM.....ADVERTISING MANAGER.

EUROPEAN AGENCIES:

KEGAN PAUL, TRENCH, TRUEBNER & CO. (Limited), Paternoster House, Charing Cross Road, London, Eng.

SAMPSON LOW, MARSTON & CO. (Limited), St. Dunstan's House, Fetter Lane, London, Eng.

SUBSCRIPTION RATES: United States, Canada and Mexico, One Year, $5.00; 6 months, $2.50; 3 months, $1.00; single copies, 15 cents. To all other countries in the Postal Union, add $2.08 per annum (4 cents per number) to above prices for postage. No club rates allowed. Mailing addresses may be changed at will by sending both old and new address. We shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.

The date when the subscription expires is on the address label on each paper: the change of this to a subsequent date is the only receipt sent, unless by special request.

ADVERTISING RATES: 30 cents per line agate measure. Want notices, special rates, see page 22. Rates for standing advertisements sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.

In our issue of Feb. 22 we published a letter from Prof. M. D. Taylor, of Louisiana State University, describing a new and very simple and convenient formula for calculating earthwork cross sections. We now learn that the original discoverer of this formula is Mr. Arthur Pew, M. Am. Soc. C. E., of Macon, Ga. Mr. Pew discovered this formula some 10 years ago, has used it extensively since then in his work, and made it public in a discussion of a paper presented at the World's Engineering Congress last summer and published in the "Transactions" of the American Society of Civil Engineers for December, 1893. Mr. Pew proposes to make use of this formula in a work which he has now in preparation on the calculation of prismoids, having already copyrighted the tables suggested by this formula. In justice to Prof. Taylor, it should be said that he did not, and does not, claim to have originated the formula in question, but learned of it through a friend of Mr. Pew's some years ago.

An asphalt pavement which won't wash is a curiosity which Philadelphians are now discussing. If the newspapers of that city can be believed, the Director of Public Works has forbidden further sprinkling of certain asphalt paved streets on the ground that the contractors who did the paving notified him that "indiscriminate" sprinkling of the pavement when heated by a hot summer sun would seriously injure it, and they would refuse to be holden by their five years' guarantee if any water at all were put upon the pavement except under their supervision. In order to protect the city's interests the Director has vetoed street sprinkling, and now the citizens are wondering whether the next move will be to take the pavement in when it rains. Remembering the chronic Philadelphia custom of deluging sidewalks with water, it is easy to see that a street pavement which won't wash is not likely to prove popular there. Whether the application of water would cause the asphalt to dissolve, melt, or shrivel up in disgust at the quality of the water which Philadelphia dispenses to its citizens, does not appear as yet; but if the pavement is really so "hydrophobic" as is claimed, we suggest that it be protected without delay by a coat of waterproof paint.

The city of Brooklyn is again confronted with the problem of a water supply dangerously small in proportion to the demands made upon it, and the engineers follow the course, once universal and still common, of recommending more pumps, more reservoirs and bigger distributing mains, instead of looking to a checking of waste by the use of meters. At the close of 1892 the city had 96,261 taps or service connections, of which only 2,262, or about 2⅓ per cent. were metered. The average daily water consumption nearly doubled in the decade ending in 1892, while the number of taps increased only about 50 per cent. For years the city has been close upon a water famine each summer, owing to the small margin between consumption and supply and the failure of the authorities to provide the sums necessary for carrying out the recommendations of their engineer as to increased supply. Recently an important and expensive addition to the works has been completed, but it followed so long after its recommendation that it was no sooner put in operation than the consumption was again dangerously near the increased supply. A few days ago a report was made public, in which Mr. Robert Van Buren, M. Am. Soc. C. E., until recently Chief Engineer of the Department of City Works of Brooklyn, advised extensions costing some $2,000,000, according to his estimates, designed to add 25,000,000 gallons to the daily supply and otherwise improve the supply part of the works. Not a word is said in the report regarding the reduction of consumption by the use of meters, although it is stated that steps should at once be taken to add another 25,000,000 gallons to the supply, since the daily consumption is increasing each year at the rate of about 10,000,000 gallons, so that the first 25,000,000 gallons mentioned would be all required about as soon as it is ready for use.

Perhaps Mr. Van Buren knows the temper of the people of Brooklyn sufficiently well to feel that it would be useless to urge the adoption of meters to a sufficient extent to so reduce the consumption as to lessen the demands for a greater supply, but to an outsider it seems as though the Brooklyn officials would do well to make at once a determined attempt to cut down the amount of water used. By a liberal installment of meters, combined with systematic inspection, a very material reduction in consumption could be effected, if experience elsewhere is a criterion. It is also to be noted that the consumption can be reduced in this way in a far shorter time and at trifling cost compared with the time and money necessary to secure additional water and make the necessary enlargements of the distributing mains.

It is to be noted also that the necessity for economical use of the water supply is much greater in Brooklyn than in most of our great cities. The area of Long Island which is available as a catchment area for water supply is limited at best, and the area not already appropriated by Brooklyn or the smaller cities on the island is located such a long distance to the east that it can be reached only at heavy expense. Further, the western part of the island is rapidly increasing its population, and by the consequent pollution of the soil, portions of the catchment area now in use by Brooklyn will eventually have to be abandoned.

It is true that the average per capita consumption of Brooklyn is below that of many American cities, but, bearing in mind various revelations which have been made during the past few years of the waste of water by large consumers in Brooklyn, it seems pretty certain that there is an opportunity for a heavy increase in consumption by the installment of meters. Of course such a decrease would be largely offset by the steady increase due to the growth of population, and it is doubtless true that the extension which Mr. Van Buren recommends will be welcome in any event by the time it is completed. We only desire to point out here that in Brooklyn, as in other cities, the prevention of waste of the present supply should go hand in hand with the provision of additional supply.

CAST IRON COLUMNS IN HIGH BUILDINGS.

A correspondent calls attention in another column to prevailing methods of detailing the connections of cast iron columns, and deprecates the carelessness with which this work is done in building construction, meaning, we presume, although he does not say so, the high building construction which has come into vogue in large cities during the last decade. Doubtless there is much improvement to be desired in the direction noted by our correspondent, but whether there is or not seems to us to be neither here nor there, for the use of cast iron columns is ancient practice, and our most progressive designers no more think of using them to-day than bridge engineers thing of using cast iron compression members in bridges. We have already expressed our views on this subject several times, and it would seem needless to do so again did not continued communications like this, and, what is of more moment than these, continued use of cast iron columns in 10 to 16 story buildings, show it to be necessary, even at the danger of threshing over much old straw.

In modern tall building construction, columns have two purposes to fulfil. (1) They must carry all loads from the floors to the foundations, that is, act as columns to support weight; and (2) they must form an important part of the system of bracing which constitutes the framework of a structure in equilibrium against all forces which tend to call into action the truss element. To properly fulfill these purposes they must have (1) continuity from basement to roof, with the requisite strength; (2) availability for the rigid connection of floor girders, keeping in mind eccentric loading and the desirability of the axial application of the loads; (3) facility of connection for wind bracing, and (4) simplicity of design to facilitate erection and to minimize errors of alinement. In connection with these the designer must have in mind cost, availability, adaptability to fireproofing, relation of size to section, and a number of minor considerations.

An ideal column for continuity would be a single piece of metal having a uniform taper, and whose section varied from floor to floor as the loads increased. In attempting to approach this ideal in a column made up of sections, one story, or, at the most, two stories in length, it is obvious that success can be attained only to the degree that the material and sections used allow of rigid connections. What does cast iron furnish us in this respect? With the sections most commonly used, the circular, square and H-shaped, the connection is secured by bolts passing through horizontal flanges. However careful the workmanship, it can be seen at once that this cannot make as stiff a connection as steel, which can be thoroughly riveted at all points. The workmanship, however, is seldom anything like perfect; the ends of the columns are not machined parallel, and the bolts never completely fill the holes. The result is that shims have to be used to plumb the columns, introducing an additional element of weakness in the connection, which, with the imperfectly fitting bolts, make it so loose that considerable distortion can easily take place.

This would not be so entirely bad if the floor girder connections were rigid, but these are as loose as the column connections. Ordinarly rolled I-beams rest on brackets cast on the column. The flanges of the I-beam are bolted to this bracket, and where possible, as in the H-section shown on another page, bolted angle connections are made between the webs of the I-beams and the column. Sometimes strap connections, wedges, etc., are used. With at the most four beams, all at the same height and on opposite sides, this connection can be made fairly satisfactory; but where the arrangement of the beams is irregular, both in plane and as to height, the difficulties are nearly, if not quite insurmountable, and these are increased if wind bracing connections are added.

In many cases of column loading in buildings there exists considerable eccentricity, that is, the loads on one side are heavier than those on the other side, and the bending strains arising from them greatly increase the stresses due to direct compression. The adaptability of cast iron columns to take such loads is small. With steel it is easy to add extra plates or otherwise change the section so as to increase its radius of gyration in

the direction of the load without materially increasing the section of the column. This cannot be done with the cast iron column in any very satisfactory way. It is, of course, true that certain forms of steel columns are not adapted to such a change as is noted above, but here it is only a matter of selecting a form which is so adapted, while with cast iron we have no such resource. Again, with the common forms of cast iron columns, anything like applying the load near the center is impossible, and all the advantages of axial applications of the load, so much to be desired in construction of this character, are lost.

Structural steel, comparatively speaking, is a uniform product, and its manufacture into columns permits of a definite and reliable inspection in every part. This is not so with cast iron; the material at one foundry is no criterion for that of another, and blowholes and other faults may be hidden by a smooth surface so as to defy inspection. These deficiencies may, it is true, be allowed for by increasing the section, that is, by allowing a greater factor of safety, but in doing this we do what we ordinarily wish to avoid in high buildings, that is, increase the dead load and bring a greater weight on the foundations. With such soils as many of the high buildings in Chicago are constructed on this is an important factor; in fact, in that city the use of steel has contributed largely to make the construction of such buildings possible, in some cases. Cast iron, notwithstanding its apparent stiffness, has a lower coefficient of elasticity than steel, and makes a less stiff structure, and when it breaks it does so suddenly and completely, while steel will suffer considerable distortion before fracture occurs.

On the other hand, cast iron columns are less costly and more convenient to erect than steel. These are considerations which naturally appeal to the ordinary builder with a strength greater than the partly understood dangers of poor structural design, and iron founders know how to make the most of them. Such ignorance is not confined to the builders alone, however. The architects of some of our high buildings have shown almost as little conception of the importance of the scientific design of framework. Within the last year a half dozen buildings, from 10 to 16 stories high, have been built in New York city with cast iron columns from basement to roof, and with not even an apology for wind bracing. The building at 14 Maiden Lane, which we illustrate in another column, is one of these structures, and except for its extreme narrowness, is no worse than any of the others. In fact, with the brackets introduced it is better than most of them. Giving cast iron columns all possible credit for cheapness and convenience—and really the margin saved by their use is very small indeed at the present day—their use in high buildings is accompanied with such serious dangers and disadvantages that common use and economy both demand that they be abandoned. Indeed it is not too much to say that the building laws of our large cities should be amended to prohibit the use of cast iron columns in buildings above a certain height. The hardship involved in this would not be so serious as may at first appear. As we have frequently pointed out, structural steel of absolute reliability can to-day be bought at so low a price (current quotations are about 1⅓ cts. per lb. at the mills) that when the extra weight of the cast iron column is taken into account the saving by its use must be exceedingly small and unimportant. As far as the foundry interest is concerned, it must submit to the advance of science, as other industries have done, and adapt itself to the new conditions.

RAPID TRANSIT PROSPECTS IN NEW YORK, BOSTON AND PHILADELPHIA.

The three great commercial centers of the East, Boston, New York and Philadelphia, are each of them seriously hampered in their development by lack of rapid transit facilities between the city and the outlying suburbs, and in each of these cities the question of rapid transit has been one of vital importance for half a dozen years. Of the three cities, New York has probably the least pressing need of rapid transit; but at present she appears to stand much the best chance of securing it. The Manhattan Elevated system does carry the people up and down the island and at a speed which is better than any surface cars can obtain. In addition to this the three great suburban residence sections on Long Island, New Jersey and Staten Island, adjacent to New York, are all reached with reasonable facility from the downtown business district, and furnish an outlet of almost unlimited extent to the rapidly increasing population. On the other hand, the elevated trains are perennially crowded well nigh to the limit of human endurance. The traffic is too heavy to permit the running of express trains, even if the structure were so solidly built as to warrant it, and the actual speed, including stops, is only 12 to 13 miles per hour. Thus the need of a real rapid transit railway system, extending the whole length of Manhattan Island and reaching the sparsely settled outlying suburbs beyond the Harlem River, is a real and great one; and now that the Rapid Transit bill passed by the last legislature has received the Governor's signature, the prospect is excellent that such a system will be secured.

In Boston and Philadelphia the introduction of electric cars has done something to lessen the time of transit between the business center and the outlying residential districts; but all about Boston the suburbs which were formerly too distant to attract many city dwellers have been rapidly growing, and the demand for rapid transit is even more pressing now than it was before the West End Co. began the work of transforming horse car lines to electric. Coupled with this is the problem of relieving the narrow streets in the retail shopping district of the congestion of traffic, which has now become so great as to not only constitute a serious danger to foot passengers, but to delay the traffic and increase the time of electric car transit by the frequent blockades which occur.

The proposition to remove the second of these evils by the construction of a subway on Tremont St., has been already described in these columns (Eng. News, March 16, July 27 and Dec. 28, 1893), and at one time seemed to be in a fair way to succeed. The legislature, however, at the present session has delved into the whole question of city and suburban transit for Boston. It has given the subway a black eye; has raised the hopes of the promoters of the Boynton bicycle system, only to dash them again; and has finally resurrected from oblivion the old Meigs system and put that forward as the system of systems for Boston relief.

The trouble with Boston seems to be a superfluity of ideas, and too much rather than too little public interest in the matter; the advocates of the different plans are each so tenacious of their own ways and means and systems, that they will not co-operate with each other; in fact it would appear to an outsider that co-operation between the different factions could only be secured for the defeat of whichever project seems at the time to be nearest success. Under all the circumstances, there seems to be no immediate prospect for improved transit facilities for Boston, badly as they are needed.

The situation in Boston, however, is by no means so bad as in Philadelphia. As many of our readers know, some two or three years ago, the Quaker City Elevated R. R. Co., and the Northeastern Elevated R. R. Co. were organized to build a system of elevated railways in Philadelphia; and the latter company actually began the construction of its road and expended some $100,000 or more. Public opinion was strongly in favor of the elevated railway system, and everything looked favorable for its construction. The Philadelphia Traction Co., however, which owns the bulk of the surface railways in the city, attacked the elevated companies in the courts and were successful in securing a decision from the Supreme Court of the State, handed down May 7, annulling the charters of the companies. The decision was based on the ground that the legislature has provided no means by which elevated railways for street passenger traffic in cities could be lawfully chartered and that no lawful method exists for adjusting property damages along the line of such roads.

As the case stands, the only hope for elevated railways in Philadelphia is by the passage by the legislature of a special enabling act. As the passage of such an act would be opposed by the Pennsylvania and the Philadelphia & Reading interests, as well as by the existing surface street railways, and as these corporate interests are possessed of widely extended influence in both state and local politics, the prospect is remote that any one will resort to the legislature for power to supply Philadelphia with elevated roads.

LETTERS TO THE EDITOR.

HYDRAULIC FORMULA FOR WATER POWER COMPUTATION.

Sir: In the formula on p. 384 of your issue of May 10, where it is stated that

$$H = \frac{L \times C}{D}$$

do you not mean

$$H = \frac{L \times C}{100\,D}\ ?$$

Yours very truly, L. Y. Schermerhorn.

Philadelphia, May 11, 1894.

(The article as printed was somewhat misleading, but the formula

$$H = \frac{L \times C}{D}$$

is correct. C is not equal to K, as might be inferred from the wording of the article, but is equal to K divided by 1,200.—Ed.)

AN ERROR IN BAKER'S "MASONRY CONSTRUCTION."

Sir: Referring to the letter headed "How Not to Make Concrete" in Engineering News of May 17, perhaps the paving commission of Ithaca drew on Professor Baker's "Masonry Construction" for their specifications. In the fourth edition, 1889, of that work, bottom of p. 103, we find:

The usual proportion for concrete is 1 volume of cement mortar to 4 or 5 volumes of broken stone, etc.

Of course this is a case of what Grant White called heterophemy. The writer was thinking of 4 or 5 parts stone to 1 cement. The usual proportion for concrete is 2 volumes of cement mortar to 4 or 5 volumes of broken stone, though that is not the "usual" way of putting it in specifications. An addition should be made to your list of errata in Baker's "Masonry Construction." H. Saxton.

Washington, D. C., May 21, 1894.

SPECIFICATIONS FOR STAND-PIPE STEEL.

Sir: In your comments on my letter regarding the Peoria stand-pipe failure, published in your issue of May 10, you seem to have misunderstood my position on one point. I did not intend the reduction of area to be placed so high that the elastic limit would become "objectionably low." The elastic limit should be maintained as usual at not less than one-half the tensile strength. This determines the allowable working stress; but the reduction and elongation, which are frequently omitted altogether, should be maintained so as to secure the desired ductility.

As all are aware, the tensile strength, elastic limit, reduction of area and elongation, within certain limits, are independent variables, hence the necessity of a requirement for each.

Very truly, Walter C. Parmley.

Peoria, Ill., May 15, 1894.

STAND-PIPE ACCIDENTS AND FAILURES.—A LEANING PIPE AT HOLDREGE, NEB.

Sir: A few years ago the city of Holdrege, Neb., constructed a system of water-works with a wrought iron stand-pipe 15 ft. in diameter and 110 ft. high on a limestone foundation resting on a bed of clay or marl about 100 ft. deep, below which is sand.

Some time after being completed the foundation settled so that the whole structure leaned to the south. Recently the city council engaged E. A. Howard, a contractor of Holdrege, to straighten up the stand-pipe, and he has just completed the job.

Mr. Howard took two T-rails about 23 ft. long and bent them to fit around the stand-pipe just under the first lap, placing them bottom up and clamping them with a ⅞-in. iron rod.

Then, after placing seven jack screws, he loosened the nuts on the anchor rods and commenced to raise the lower side, blocking it up as he went until the south side of the bottom of the stand-pipe was 0.61 ft. above the foundation, which would indicate that the stand-pipe was 4.47 ft. out of plumb.

M. D. Case.

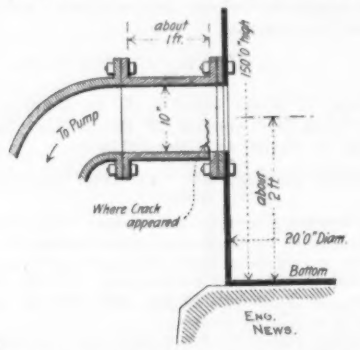
Atlanta, Neb., May 9, 1894.

(This, we believe, is one of the few stand-pipe accidents which have escaped the notice of the author of the series of articles on "Stand-Pipe Accidents and Failure" just being concluded in these columns. Doubtless there are some other accidents which have been considered of too little interest for notice outside of local papers, which have not come

to the attention of Prof. Pence. If any of our readers know of such we should be pleased to have them inform us at once, in order that they may be noted in these columns and included in the publication of the above articles in book form. The water-works at Holdrege were built in 1888.—Ed.)

STAND-PIPE ACCIDENT AT BAYSHORE, L. I.

Sir: In response to your telegram I would state that the accident to the stand-pipe of the Great South Bay Water Co., at Bayshore, Suffolk county, N. Y., was as follows: At about 5 p. m., Sunday, May 20, the shank of the supply pipe cracked from the flange throughout the lower semi-circumference, at the end which is bolted to the stand-pipe, as shown in the accompanying sketch. The stand-pipe was nearly full at the time of the accident, and the break was undoubtedly caused by the vibration of the stand-pipe due to the high wind blowing a gale from the east, the supply-pipe being at the opposite side. The stand-



Break in Supply Main to Stand-Pipe at Bayshore, L. I.

pipe was 20 ft. in diameter, and 150 ft. high and was furnished, erected and connected by E. Hodge & Co., of East Boston, Mass., in 1890. Guy ropes were provided at the time of erection but were never secured at the lower ends.

The water service is being maintained by direct pressure from the pumps, pending repairs, which will probably be made in two or three days. Flexible joints will replace the former rigid ones to prevent recurrence of a similar experience. Yours truly,

Eugene R. Smith, Jun. M. Am. Soc. C. E.

Islip, Long Island, May 21, 1894.

LITIGATION OVER CAR-HEATING PATENTS.

Sir: We have been asked whether the recent litigation in which was involved the patent of Elmore D. Cody for a system of car-heating, in any way affected this company. We therefore deem it advisable to state that this litigation in no way involves any of the systems of car-heating sold by us, either by hot water or direct steam. Every system used by us is covered by letters patent owned by us.

The Safety Car Heating & Lighting Co.,

By Robt. Andrews, Vice-President.

New York, May 21, 1894.

ADJUSTING COMPASS ZEROS ON TRANSITS.

Sir: We find in your issue of May 10 a letter from W. H. Tinker, City Engineer, Coronado, Cal., which interests us. We do not know what make of instrument Mr. Tinker used, but in our own transits we always make the line of collimation agree with the zeros of the needle by removing the objective from the telescope and inserting another that will have a proper focus to see clearly the zero lines. The telescope is then made to cut both zeros, and fastened there. It is a fact, however, that no two compass needles can be depended upon to give exactly the same magnetic meridian at different times, nor when used in the same instrument, which is one of the insurmountable obstacles connected with the use of the magnetic needle.

Yours very truly, W. & L. E. Gurley.

Troy, N. Y., May 16, 1894.

MOLDS FOR POURING LEAD JOINTS.

Sir: No doubt the great majority of your readers were as much surprised as myself upon reading the article in your issue of March 22, relating to a "clamp mold," or device for pouring lead joints, information regarding which was sent you by Mr. Hiram Phillips, of St. Louis, Mo.

My patent for this article was granted March 27, 1883, and it was advertised for some years in the News.

The "discovery" of Mr. Phillips, of St. Louis, is shorn of its charm of originality by the fact that for the past ten years Messrs. Ripley & Bronson, of St. Louis, have sold hundreds of these articles and are at present doing a large business in that line.

Yours respectfully, Thomas Watkins,

Mfr. of Watkins Pipe Jointer.

Johnstown, Pa., April 12, 1894.

The claim set forth in Mr. Watkins' jointer patent, with letter references omitted, is as follows:

The combination of a rubber gasket and flexible band, provided with lugs, a clamp and set screws, which are passed through the clamp and made to bear against the lugs, the space between the ends of the gasket being closed by a filling of suitable material while the joint is being formed.

(The device used by Mr. Phillips and illustrated in our issue of March 22, consists of a piece of rubber packing, without the steel band used by Mr. Watkins, and described in a circular sent to us by him The clamps for the two molds are also different.

In this connection the following letter from British Columbia, describing the use of a greased rag for pouring lead joints will be of interest.—Ed.)

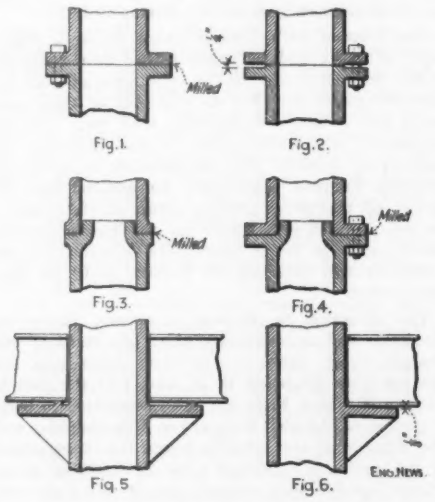
Sir: About 20 years ago the writer was engaged in laying 4 and 6-in. lead-jointed cast iron pipe, using clay molds for pouring the lead. Great difficulty was experienced on account of moisture in the clay molds causing steam to form, blowing out the mold. An old gentleman looking on volunteered the information that 40 years previously he had used for a mold cotton cloth heavily coated with beef tallow. An old cotton sack and a piece of tallow were furnished him. He coated the cloth (cut from the sack) on both sides with tallow, doubled it three-ply and passed it around the joint, then taking hold of both ends of the cloth in one hand, he gave them a half-twist and the mold was ready for pouring the lead.

Thousands of feet of pipe were laid afterwards by this method without the least trouble. By keeping the hands and arms well coated with tallow, it will protect them from the molten lead. This method is not patented. I remain, yours, B. B.

British Columbia, April 14, 1894.

DETAILS FOR CAST IRON COLUMNS.

Sir: The several discussions which have appeared in Engineering News during the last few months (Eng. News, Nov. 9 and 23, 1893, and Jan. 11, 1894) regarding the use of cast iron columns in building construction suggest a few remarks concerning methods of detailing such columns so as to make the connections rigid and properly distribute the loads on the beams. Column bases are made by the iron companies in all



Some Details of Cast Iron Columns.

shapes and sizes; some needlessly large and others ridiculously small, some with ribs and some without ribs, and many without any apparently definite method of calculation. Authorities vary so widely as to the allowable pressure upon granite and brickwork that a few reliable figures from actual tests would be of great value. Without doubt, however, it is safe to say that at least one-half of the base plates for columns are never figured according to the formula,

$$\frac{b\ d^2}{6};$$

but are simply guessed at (by men of experience).

The next detail of importance is the way in which the columns are fastened together. There are four distinct ways now in use. The connection shown in Fig. 1 is the most common and that in Fig. 2 the most sensible and practical, while those in Figs. 3 and 4 are expensive and useless. The first connection, Fig 1, is objectionable, for the reason that if the column is not milled perfectly perpendicular to its axis, all the load will be thrown upon one side of the flange, which is not only likely to break off but will throw the load all upon one side of the column. This can be avoided, however, if the detail shown in Fig. 2 be used. This connection, moreover, having less surface to mill is less expensive. The connection shown by Fig. 3 is expensive both in the shop and field, and especially dangerous to erect, since it is liable to be displaced with serious results. Fig. 4 shows a detail made by the supervising architect at Washington, and can be seen at the new Appraiser's Stores on Christopher and Greenwich streets, in New York city. The exact advantage of this construction is not entirely plain. It is necessarily expensive and can be of no use except to center one column above the other, which is fully accomplished if the bolt holes in the flanges are drilled to template.

In the Engineering News of Jan. 11, 1894, there appeared an article showing how to arrange lugs on columns so as to overcome the eccentric loads by placing on them projections, as shown in Fig. 5. This, however, is of no use except for constant loads, such as dead loads, and does not provide for live loads, which may come entirely upon one side of the column. A more practical method is one which brings all loads as near the center line of the column as possible. This may be partially accomplished as shown in Fig. 6. This method also avoids any bending strain upon the bracket, which is always one of the weakest parts of the column on account of the unequal cooling of the metal. G. A. L.

New York, April 2, 1894.

THE ELECTRO-PNEUMATIC AND MANUAL INTERLOCKING SYSTEMS COMPARED.

Sir: We desire to call your attention to some statements in your article entitled "A Complicated System of Railway Tracks" in your issue of Nov. 16, 1893.

We are not advised as to your source of information concerning the Stewart Ave. plant; but since you make a comparison between the efficiency of the manual and pneumatic systems, which is against the use of the manual for complicated work, it is to be presumed that you are fully informed as to the details, cost of construction, maintenance and the probable life of the electro-pneumatic apparatus as a whole, and that you have made a careful study of the best practice in manual machines controlling similar situations both in this country and abroad.

You state that "the work was done during the past year"; we find the time consumed in building the plant was two years. You say, "To have handled all these parts, together with the accompanying locks, detector bars, etc., on an ordinary lever machine using the English practice of connecting parts would have required one with 275 levers." . . . "A 275-lever machine would require a constant attendance of probably not less than twelve men, which, by dividing the day into three parts, would mean 36 men, besides the repair men and train directors; 36 men at $50 a month each would equal $1,800 per month, or $21,000 per year, which is 6% on $360,000."

We do not understand why you should go to England for information concerning the "ordinary lever machine," for it is well known among signal experts that we have many of the most complete types of the "ordinary lever machine" in and about Chicago, notably at Weldon Yard and 75th St.; but, presuming that it is necessary to examine English practice for a comparison of values, we invite your attention to the largest signal plant in the world which is operated by the "ordinary lever machine," the plant at Waterloo Station. This plant is controlled by 236 levers, which work 247 signals (as against 86 at Stewart Ave.), 81 switches, and 68 facing point locks. Of the 236 levers, 16 are to assist in locking and 15 are spare levers, making the total number in active operation for the manipulation of signals, points and locks 205. But supposing it would require the use of 275 levers to work the system at Stewart Ave., the cost of construction, maintenance and operation of a 275 ordinary lever machine would be much less than the cost of the electro-pneumatic machine. The first cost of a lever machine using 275 levers would not exceed $65,000, which is a direct saving of $35,000.

You say it will require 36 lever men, besides numerous repair men, to work this plant, and that the cost would exceed $21,000 annually. We refer you to "English practice" for information in this regard. The Waterloo station plant uses not to exceed 12 lever men for 236 levers; we will allow two additional for the extra 39 levers, which you claim would be necessary at Stewart Ave., which, together with three repair men, makes 17 men. We will allow 20 men. Having no delicate mechanism, constant power, or complicated electrical apparatus to maintain, the manual interlocking system does not require expert service, and no doubt such ser-

vices as would be required for this work could be secured for $50 per month, as you say, but we will allow $60 per month, or a total of $1,200 per month. You have not given the cost of operating and maintaining the Stewart Ave. plant. We are reliably informed that the cost of operating this plant for the first six months, all parts being new and in perfect adjustment, and consequently needing little of the attention which may reasonably be expected to be required with increased use, has exceeded $1,875 per month, or at the rate of $22,500 per annum, as against $14,400 for an "ordinary lever machine."

The life of an interlocking plant at a busy point like Stewart Ave. will probably not exceed 15 years. That is, we may calculate that the cost of maintenance will equal a renewal of the plant every 15 years; we believe ten years to be the limit. With the foregoing figures in view, a recapitulation of results covering a period of one year shows the following results:

Electro-Pneumatic Machine.		Ordinary Lever Machine.	
First cost	$100,000	First cost	$65,000
Operation	22,500	Operation	14,400
	$122,500		$79,400

Difference in favor of Ordinary Lever Machine.

First cost	$35,000
Operation	8,100
Interest on diff., $43,100, @ 6%	1,386
	$44,486

Which is 6% on $741,443.

The cost of operating the electro-pneumatic plant at Stewart Ave. is found from the above figures, being the actual results for the first six months, to be 22½% of the first cost, with 1,031 train movements during the 24 hours. A statement for 1891 shows that the manual plant at the Grand Central Station, New York, handling 2,400 trains, as against 1,031 at Stewart Ave., cost only $1,300 per month.

The electro-pneumatic plant at Oakland, Cal., manipulating 22 pot and 53 semaphore signals, 63 switches and protecting one drawbridge; also 52 automatic block signals, cost about $80,000 for installation, and the current cost of operating and maintaining this system averages $1,600 per month.

Concerning the deterioration of a manual plant, as compared with the electro-pneumatic, we maintain that the latter not only requires experts to install the system, but experts to maintain it.

The system installed on the Pennsylvania R. R. at Jersey City, consisting of three towers, with a total of 105 levers, requires the constant attention of six repair men, at a cost of $70 per month each, while the 30 mechanical interlocking towers, scattered over the line between Jersey City and Philadelphia, with a total of 758 levers, require the attention of but six repair men at an average salary of only $55 per month.

The claim is made in your article that "On a manual machine he would have thrown 35 levers and worked hard to have finished in 70 seconds." This refers to the setting up of a route comprising "five movable point frogs, four single switches, five double-slip switches and give two signals." We have not had sufficient experience to determine the exact number of seconds required to throw 35 levers, nor is it necessary to require 35 levers for this movement; but accepting your figures as to the number of levers and the total time required for one person to throw same, we call your attention to the fact that you have charged the manual plant with requiring "not less than 12 levermen" in constant attendance; now it is fair to presume that these 12 levermen are competent and are supplied for service. In this view of the situation, we find 12 men ready to throw the 35 levers, and by a simple calculation, dividing the labor equally among them, we find the time to be less than six seconds. We now see that the claim for the electro-pneumatic, for increased speed, is not sustained; and it has also been demonstrated that its efficiency is no better sustained, for with a manual lever machine the switches and signals respond to the movement of the lever, being positively connected, whereas with the electro-pneumatic, using electricity as a prime mover, and having no positive connection between the lever and the switches or signals, the switches frequently fail to move in accordance with the movement of the switch lever, and the levermen frequently "plug" the indications to make the lever correspond. This "plugging" has occurred so frequently that it is made prohibitory by "rule."

Since you refer to English practice, it may be well to state that after extended tests of power plants, the railways of England have pronounced against them and the only power plant to be found in the kingdom is the exhibition plant of Saxby & Farmer, at their works.

It may interest your readers to have your explanation of the reason for removing all the detector bars from the Union Depot plant at Kansas City, as this plant was put in by the Union Switch & Signal Co., and is an electro-pneumatic plant.

We believe no signal man will advise the use of such a plant without the safeguard of the detector bar, and yet it appears that the detector bars could not be operated successfully at Kansas City.

We do not believe that you intended to favor the electro-pneumatic system as against the manual system, and yet you seem to have done so.

Chicago, Ill., April 23, 1894. Manual.

(Our correspondent is correct in his belief that this journal takes no sides in the discussion of the relative merits of manual and automatic interlocking plants, but desires to give the parties representing each system equal opportunities to present their views. The information from which our original article was prepared was furnished to us by the designing engineer of the plant, supplemented by some additional data from the contractors. We have submitted proofs of the above letter to them for such replies as they see fit to make. We may note that "Manual's" statement respecting the number of men employed at Waterloo station is in part a repetition of information given in a letter by Mr. John P. O'Donnell, in our issue of Jan. 11.—Ed.)

A COMBINED GAS AND ELECTRIC LIGHT PLANT AT CIRCLEVILLE, O.*

By Dr. Howard Jones.

In small towns the lighting is often divided between two or more companies, with the result of cutting down the dividends of the gas company and the electric company to a point where net profits sometimes cease to exist. It is upon the desirability of combining the gas and electric interests of such towns, with a view of making each more profitable, that I wish to speak, and the specific figures which I shall present to you are given with a feeling that their correctness can be depended upon.

Circleville has about 7,000 inhabitants. In 1859, a coal gas plant was established with gas at $5 per 1,000 ft. This plant did a good business from the start, and in 1885, when the Edison people captured the town, was selling gas at $2.50 per 1,000 ft., and earning good dividends. Early in 1886, a 1,000 Edison incandescent electric plant turned on its current under flying colors. Thirty-two stockholders were resident storekeepers and business men. At a public banquet 50% dividends were promised. At once the price of gas was dropped to $1 per 1,000 ft., and the fight was on. The combat was one of capital and influence with a beautiful new invention, against a rich and cursed monopoly, with the result that each plant lost money. The Edison plant in two years had expended $55,000. In 1888, the two companies, seeing the fate ahead, combined and raised the price of gas to $2 per 1,000 ft., and the incandescent current to the same ratio. For two years the companies made money. In 1891, the gas contract for street lighting expired, and the citizens demanded arc lights. Each company decided to bid for the lighting, and after considerable wrangling, the gas company obtained the contract to light 119 or more 1,200 c. p. arcs for 10 years, at the rate of $75 each per year. The gas company at once began construction, and at the same time arranged for power for an alternating incandescent circuit. The price of gas was reduced to $1.50 per 1,000 ft. to small consumers, and scaled down to 75 cts. per 1,000 ft. according to quantity and time of day of consumption. This resulted in the purchase, in February, 1892, of the Edison plant, by the former gas company, for a little over one-fourth of its cost. Its machinery was soon removed into the building of the arc plant, which was erected with an eye to the event, and now for two years and over, gas and electricity for arc and incandescent light have been furnished by one company from, practically, under one roof.

Without any material increase of population, the gas sales have reached a point where they are quite satisfactory. Only about 100 stoves are in operation. This field we believe has before it a promising future. Incandescent current is sold partly by meter and partly by contract, but after May of this year no more contracts will be made for more than three lamps to a single individual. There is a great disposition on the part of citizens to have incandescent light in their dwellings and places of business. By meter the current sells at the rate of $1.60 for 10,000 watt-hours, or $1.60 for 100 milligrams (Edison meter) (equivalent to about 0.9 ct. per lamp hour.—Ed.), but this small difference of 10 cts. above the price of gas does not deter people from using it in preference. This simplicity, the convenience, the freedom from smoke, smell and dirt recommend it strongly to the modern housewife. To be able to light up a closet, cellar, stable or any room or place which you are about to enter by simply turning a switch is fully appreciated by this utilitarian age. The incandescent light is gaining slowly but surely over gas for illuminating purposes. To-day this plant has over 2,100 sockets hung, running through 200 services. The number of gas meters for light is about 300. The comparative sales of incandescent current to gas are in the ratio of 6 to 9, and I believe that before long it will be as 9 to 9. The profit upon the incandescent current is not large. In fact, it is far from sufficient. In proportion to the capital invested in each, the incandescent plant earns 50 cts. when the gas earns $1, but this estimate includes the profit from gas sold for heating as well as lighting. The lamps are sold to the consumer about at cost.

The arc system in use is the Fort Wayne. Three machines of 50 arcs capacity each are run. They have given perfect satisfaction to the company and to the city. No serious difficulty has been experienced with them. The lamps are the Wood double ratchet. Not more than one or two fail to start at a time, and frequently the entire 119 start up. There are three circuits of a combined length of nearly 20 miles. The earning capacity of this plant, in proportion to the money invested, is about equal to that of the gas plant or double that of the Edison plant.

If the arc plant were to run by itself it would not make money under our present contract. A few accidents would in fact make it a loser. Running all dark hours amounts to about 2,500 a year. In 1893, we ran 2,534 hours. Counting one arc in the engine room, we operated last year 120 arcs, consuming at a fair allowance one indicated steam horse power each, 2,534 hours. The number of arcs (120) multiplied by the number of hours (2,534) will give the horse power hours (304,080). We used about 5 lbs. of coal to develop each indicated horse power; this makes the total amount of coal for one year equal 760 tons, which at 90 cts. per ton, cost $684. Actually we do a little better than this. The other items of expense for a year, if the plant were isolated, are as follows:

Carbons	$900	Superintendent	$1,000
Water	75	Engineer	720
Oil and waste	70	Fireman	600
Taxes	225	Two trimmers	1,080
Insurance	150	Extra labor	400
Total for supplies	$1,120	Total for labor	$3,800

The item of wear and tear has been variously estimated. Five per cent. of the cost of the plant seems to me a reasonable amount; $1,500 added for wear and tear brings the total expense for a year to $7,104. The income from 119 lamps at $75 each per year is $8,925. This leaves a balance in round numbers of $1,800 for net earnings, or 6% on the investment of $30,000, evidently a very small interest, considering the doubtful condition of the undertaking. A single accident might wipe out several years' profit. Such a plant combined with a gas and an incandescent electric plant will show better for the shareholders, and consequently it is of importance to every city to have such a combination, as this is their only hope for cheap light.

When run in combination, the items given above are practically the same, with the exception of labor. In this department the cost is divided. There is, in addition to the labor enumerated, the salaries of the officials of the company, which must be borne in common. One-third the time of Superintendent, President, Secretary and Treasurer, amounting to $1,110, must be added to one-half time of engineer, $360; one-half time of fireman, $300; two trimmers, $780; one-half time of wiper, $180; extra labor, $480—making a total for labor of $3,210. To this add for coal, carbons and other items stated above, $1,804, and $1,500 for wear and tear, and we have a total of $6,514 as the cost for running for one year. This amount deducted from the income leaves $2,411 net, or 8% on the investment.

The Edison plant has about 2,100 sockets hung, and every night carries a maximum load of about 400 amperes, excepting during the holiday season, when this amount is considerably exceeded. We have a small engine and dynamo to carry the load during the latter part of the night and during the daytime. To run this plant by itself one year with collections for the year of $6,000, costs as follows:

Superintendent	$1,000	Oil and waste	$70
Engineer	600	Water	60
Fireman	480	Tax and insurance	350
Boy	360	Wear and tear (6%)	1,500
Extra labor	360	Coal	500
Total for labor	$2,800	Total, fixed charges and supplies	$2,480

This makes $5,280 total disbursements and leaves net earnings of $720. Valuing the plant at $25,000, its earning capacity is found to be about 2.9%. These figures are upon a scale of strictest economy.

This same plant in combination with the arc light and gas can be operated one year with the same output and the same income, for the following cost:

Superintendent, President, Secretary and Treasurer, one-third time	$1,110
Engineer, one-half time	360
Fireman, one-half time	300
Wiper, one-half time	180
Office man, one-half time	180
Part time of one trimmer	180
Extra labor	180
Total for labor	$2,490

Other items remaining the same as when the plant was isolated ($2,480), makes total expense for one year

* Condensed from a paper read before the Ohio Gas Light Association.

$4,970. A net profit of $1,030, or 4%, on the capital, $25,000. This seems an inadequate interest for such a perishable investment, and so it is; but it is better by far than to have the incandescent plant in opposition hands.

The item of depreciation has not been considered, except as it occurs under wear and tear. If in a series of years the arc or incandescent, or both, shall be displaced by something better, then, of course, dividends would be swallowed up. If you are owner of a gas plant, you may say: "Let the other fellow go into the incandescent electric light business. Let him lose his money. He will finally go out of the venture a wiser but sadder man." In fact, he will do nothing of the kind. Once in he will stay in. He will continually increase his income. He will enlarge his business in spite of you. Materials necessary to maintain the station are becoming cheaper and cheaper, and as time goes on the earnings of the station will be larger and larger, and finally the sale of incandescent light in small towns will equal if not exceed that of gas for illuminating purposes.

In regard to the annoyance of the two systems, we find more trouble in the production of gas than in the production of electricity. In other words, there are less trouble and worry, less constant vigilance required in running and maintaining electrical machinery than in manufacturing gas. The difference is not striking, because each requires skillful watchfulness to avoid errors and accidents; but there is a difference, and I believe it is against coal gas. It requires more learning and more training to maintain a constant supply of good coal gas, without mishaps or accidents, than to attain the same efficiency in the production of the electric current, either arc or incandescent.

A NEW LOGARITHMIC CROSS-SECTION PAPER.

Mr. John R. Freeman, M. Am. Soc. C. E., of 31 Milk St., Boston, Mass., has recently caused to be engraved two new logarithmic cross-section plates which are better than any other now in use, to our knowledge. The many uses to which such paper can be put were explained in an article by Prof. W. F. Durand, in our issue of Sept. 28, 1893. They are doubtless already known in a general way to most of our readers who have occasion to do much computing, but as it is only recently that it has been possible to get such paper, few realize how much aid they might get from it. We venture to quote from Mr. Freeman's letter accompanying samples of the sheets, some interesting details as to how the plates were constructed:

The sheet which is marked "10-in. Base," is, I think, a great improvement over any logarithmic paper heretofore published, as it enables one to cross the border line into the next square with much greater convenience. The sheet on the 20-in. base was my first attempt, but I soon found it convenient to paste from two to four of these sheets together in order to cross over into the next square, hence I had the second sheet engraved on the 10-in. base.

You will, I think, be interested to note the accuracy with which both of these plates are printed; in fact, I have never seen any cross-section paper of whatever kind in which there was so little distortion. You may be interested in a brief description of how this was done.

We happen to have a lithographic outfit in connection with our plan department for the Associated Mutual Insurance Cos., and so I had one of our expert draftsmen make his ruling directly on the stone itself, thus avoiding the stretching and distortion which are incident to any transfer. As a starting point for the graduation, we had Darling, Brown & Sharpe cut three steel scales in their very best manner and according to a table of distances taken, of course, from the standard table of logarithms, so that each division was accurately spaced within probably less than one-thousandth part of an inch; then for ruling the stone, we clamped two of these scales to the two edges of the stone firmly, by screw clamps, and provided a thick steel straight-edge running across the stone surface on the surface of these two steel scales. Screwed to each end of this steel straight-edge was a little steel knife-edge adjusted to drop into each graduation of the steel scale; thus the placing of our steel straight-edge was made purely mechanical in exact adjustment, although it was moved along from line to line over the stone by hand, since the knife-edge was so shaped as to fit the graduation notch in the scale with accuracy.

To carry the ruling pen, a device which I first patched up some 15 or 20 years ago was used with success. This consists of a very light metallic clamp for carrying the drafting pen, which clamp is in fact formed of triangular pieces forming the three adjacent corners of a cube and having a little guide that runs along the steel straight-edge. This clamp makes it impossible for the pen to be held otherwise than vertical, and also retains the blades of the pen at all times parallel to the straight-edge. We thus avoid, in the first place, personal errors due to placing the ruling straight-edge, and, second, personal errors due to not holding the pen in absolutely the same position every time.

When it came to the lithographing, our lithographer was able to print on dry paper, instead of dampening the paper as is the usual custom when printing. The red color of ink is adopted as showing lead pencil marks distinctly.

The method of ruling scales outlined above is a practical kink which frequently is of great convenience. The writer has had occasion to graduate many accurate scales for use in hydraulic experiments, and has found that by starting with a good Darling, Brown & Sharpe steel scale as a basis, this could be reproduced with scarcely a thousandth of an inch variation from the original by means of a drafting pen held in a light clamp as above described, guided by a try-square located by means of the little knife-edge fitting into the graduations on the steel scale. Straight grained and well seasoned pine, painted with three coats of white lead and with each coat of paint smoothed off by fine sand paper, before the next one is applied, makes a most excellent material for a scale board. The surface when properly sand papered, takes India ink from a drafting pen very nicely indeed, and as the India ink is not soaked up or blurred by shellac varnish, the scale can then be protected from wear by two or three good coats of shellac.

I have lithographed a few sheets of tracing cloth with the 10-in. logarithmic diagram. It has occurred to me that one who is mathematically inclined could solve a great variety of problems by two sheets of logarithmic cross-section paper, the bottom sheet being printed on firm drafting paper and the top sheet being on tracing cloth, but I have not yet given this matter much thought.

FAILURE OF A HIGH BUILDING BY WIND PRESSURE, NEW YORK CITY.

The danger of loose jointed cast iron construction for high buildings has, perhaps, been nowhere more clearly shown than in the accident to the 10-story

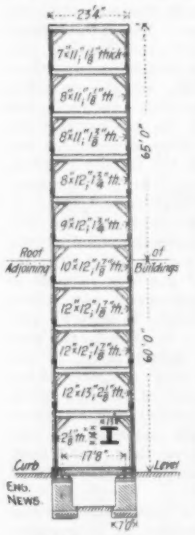


Fig 1. Cross Section.

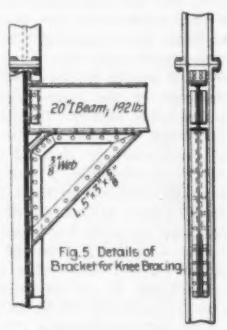


Fig. 5. Details of Bracket for Knee Bracing.

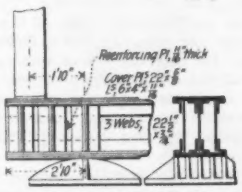


Fig. 3. Details of Cantilever Supporting Columns.

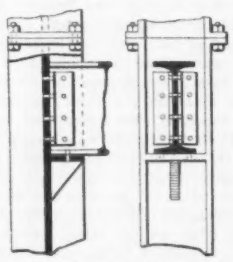


Fig. 2. Original Design for Connections bet. Columns and Girders.

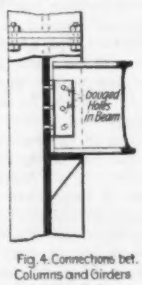


Fig. 4. Connections bet. Columns and Girders as executed.

Failure of Framework of a High Building by Wind Pressure.

building, No. 14 Maiden Lane, New York City, which we illustrate in the accompanying cuts. Incidentally it may also be noted, the accident throws considerable light on the question of how far the inertia of the walls can be depended upon to resist wind pressure, it being quite frequently claimed that this is sufficient to render wind bracing unnecessary. It is not necessary to discuss where the blame for this accident lies; it is sufficiently obvious at a glance. Its chief importance and the main reason for its publication at this time are because of the illustration which it affords of the necessity and pertinance of the remarks concerning the use of cast iron columns in high buildings which are made by a valued correspondent in another column of this issue. We, therefore, give the facts as concisely as possible and leave our readers to deduce their own conclusions.

A sectional front elevation of the building, showing the dimensions of the columns and the arrangement of the transverse girders is given in Fig. 1. It should be noted that the brackets here shown were not put in until after the accident. The building has a width of 23.31 ft. and a depth of 65 ft., and rises 125 ft., or 10 stories, above the curb level. For the first 60 ft., about 4½ stories, the building is protected on each side by the adjoining buildings, but the remaining 65 ft. is exposed to the force of the wind on all sides. The columns are of cast iron, of H section, and are placed in the walls 12½ ft., 12 ft. 7 ins., 14⅓ ft., 8 ft. 10 ins., 8 ft. 10 ins., and 5 ft. 8 ins. apart, beginning at the front. The different panels are connected at the floor levels by I-beams in the walls. The connections of the columns and transverse girders, as designed by the architect are shown in Fig. 2. Other details of the iron work are shown in Figs. 1 and 3.

The accident occurred last October during an unusually heavy wind storm. At the time of the accident the iron work had been practically completed, and the brick walls were finished to the top of the eighth story, leaving only the naked iron work of two stories exposed to the wind. The morning after the storm it was found that the whole structure, from the top of the fifth story upward, had swung over to the west so that the top was some 11 ins. out of plumb. An examination showed that instead of the beam connection designed by the architect (Fig. 2) the connection shown in Fig. 4 had been used; that the bolt-holes were too large for the bolts and that hoop iron shims had been used to plumb the columns, besides minor defects. It was also further discovered that the ironwork had simply swung over until the loose bolts and other parts had come to a bearing and then stopped. Shortly after the accident the ironwork was pulled back into position and the connections strengthened, as shown in Fig. 5. This work cost the contractor about $10,000. The building is now completed and occupied.

THE CHENAB WEIR.

By Louloun Francis MacLean.*

The Chenab Canal, in the Punjab, India, was opened in July, 1887, but on account of excessive silting of the first few miles during the flood season it was found impossible to obtain enough water for irrigation purposes; and, in consequence, a project for the conversion of this "inundation" canal into a perennial one, with a weir and permanent head-works, was prepared in 1889 and was sanctioned by the government in January, 1890. The site of the works was at Khanke, 10 miles below Wazirabad. The alinement of the weir makes an angle of 75° with the axis of the river, and the water-way is 4,000 lin. ft. The weir is divided by piers, 10 ft. wide, into eight spans or segments of about 500 ft. in length; and on the crest are fastened cast iron hinge-blocks, held down by bolts carrying wrought iron falling shutters, 6 ft. high and 3 ft. wide. These can be raised by a crane traveling on a 4-ft. gage railway, immediately below the shutters, and can be dropped from the abutments and piers by means of a winch and a rope-and-fall.

The falling-shutters are of novel construction, and the contrivances for raising, holding and dropping them have been arranged by the author. The cost of the shutters erected on the weir is only about $10 per ft. run. Wooden strips at the sides of the shutters project about ½ in. beyond the angle bars and the shutters are prevented from touching one another by a saw-cut between them, which is a feature worthy of attention.

The railway on which the crane travels is continuous along the weir, and on each pier and on the abutments small crab-winches are fixed for winding up the 1-in. flexible steel-wire ropes by means of which the shutters are dropped. The piers extend up-stream in stone

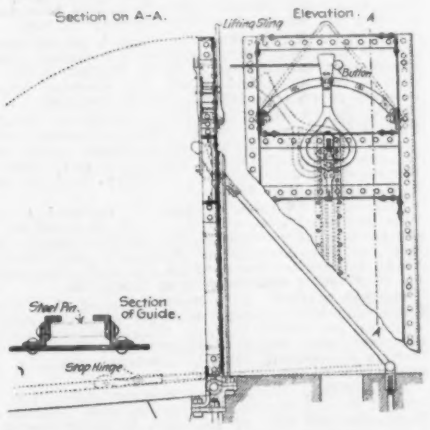
* From selected papers of the Institution of Civil Engineers.

groins about 200 ft. long, and down-stream in masonry walls 50 ft. long, with masonry groins 120 ft. long in continuation of them. By this means the river is prevented from flowing over the weir in oblique currents to any great extent. At each abutment shelters for the cranes are provided. When the river is too high for the cranes on the railway to be used, the shutters are raised from boats with cranes projecting over the stern, dropped down from moorings above the weir. It is obvious that the weir, being divided into sections of which the shutters can be worked independently, gives great control over the river.

In order to effect easy communication with the piers, and across the weir in times of flood, a steel-wire rope carrying a cradle has been erected. The rope is 4½ ins. in girth, continuous over the standards throughout the length of the weir and under-sluices, whilst at each end-standard it passes over wheels and is strained by weights of 8 tons. The effect of this arrangement is that when the cradle is passing over a span, the tension of the rope remains nearly constant, but the dip increases in proportion to the weight of the cradle and its occupants; whilst in an unloaded span the dip is only about 5 ft., the levels being arranged so as not to interfere with passing boats. The level adopted for the crest of the weir is supposed to be nearly the average level of the river-bed, and when the shutters are down there is usually little or no heading-up of the river by the weir.

In order to drop similar falling-shutters, previously used on Indian weirs, it was necessary for a man to go out and knock them down with a hammer—a method that was always inconvenient and often dangerous, especially when the work had to be done during the night; but if the water went over the top of the Chenab weir, it would in no way interfere with the process of dropping the shutters.

The author has devised the arrangements shown in the cut, by means of which falling-shutters can be dropped from any fixed point by a rope or chain having a heavy ball at the end. A forked trigger fitting into a slot in a hook holds the shutter against pressure in front of it. The fork at the upper end of the trigger



Device for Operating Falling Shutters, Chenab Weir.

sustains a 1-in. flexible steel-wire rope, of sufficient length to reach across one of the segments of the weir, and continuously supported on these forks from the winch which is used to drop the shutters; a steel ball is attached to the end of the rope, so that when the latter is wound up by a winch the trigger revolves round the bolt, the tongue leaves the slot in the hook, the ball slides out of the fork, and the shutter falls. When the ball leaves the fork, it hangs loosely at the end of the rope, until, by winding up the rope, the ball is brought up to the next fork in which the rope rests, and another shutter is then dropped as before, and so on. The arrangement is such that when the rope is being pulled for the purpose of dropping a shutter, the ball cannot slide out of the fork till the tongue of the trigger is clear of the hook. The design provides that the trigger shall be capable of being worked from either side, so that when the shutters are being dropped from a pier, the same winch suffices to drop them in two adjacent bays. If it is desired to drop, say, every second or third shutter, it is only necessary to remove the rope from the intermediate forks. This arrangement has worked perfectly on the Chenab weir, where the shutters are dropped at a distance of 250 feet from the winch; but there is no reason why the arrangement should not work at greater distances.

In all other cases in which such hooks and bars have been used for supporting falling-shutters, as far as the author knows, there has been no arrangement to guide the hook to the hole in the shutter, through which it must pass before the trigger-tongue can be put home; and, in the case of weirs, the work has to be done by a man standing in or diving into the water on the up-stream side of the shutter. The automatic guide with the stop-hinge does away with the necessity for this, as the hook is forced to travel up and down the face of the shutter as the latter rises and falls; so that when the shutter rises to its final position, the hook must have passed through the hole in the shutter, and must be in position to receive the tongue of the trigger, which is then put home by an attendant. The hook is fastened to the supporting-bar by a hinged joint—a pin projecting on both sides, under the top flanges of the guide, so that it cannot be removed except by sliding it out at the lower end. It has a stop-hinge at the back, forming part of the above-mentioned hinged joint, which fixes it in its true position to enter the hole in the shutter at the top of the guide; the angle between the top of the hook and the top of the hole in the shutter is such that the surfaces easily slide on one another, so that when the shutter rises and by means of the stop-hinge forces these surfaces into contact, the hook glides through the hole in the shutter to its position.

The guide is carried down to the bottom of the Chenab-weir shutters; but if it is considered advisable in any case to allow the head of the tie-bar to leave the guide when the shutter has fallen through any particular angle, the sides of the guide should be curved laterally, so as to release the cross-pin at the desired point.

The upper part of the jib of the crane used is horizontal and is capable of turning over the tops of the shutters and also of passing under the iron roofs which span the openings in the piers through which the railway passes. As it is intended to house the cranes if necessary in these openings during floods, or when not in use, the jibs have been designed to fold back, so as to permit this. When lifting a shutter by the crane, the jib is turned up-stream at an angle of about 45° and fixed in that position, and the crane is moved along the railway till the end of the jib is opposite to the center of the shutter to be raised. The hook of the tackle is fastened to the sling of the shutter, which is then raised by winding up the tackle. It was feared that the twisting action thus brought to bear on the crane would cause the wheels to mount the rails, but this has never happened, the weight of the crane preventing any such occurrence; it would be easy, however, to clip the crane to the rails if necessary. The guide has worked in a most satisfactory manner, although at first it was feared that it might become clogged.

The construction of the weir was commenced in January, 1891, and was completed in February, 1892, the works being carried out under the direction of the author.

The running of a steamship's engines in spite of a broken crank pin is a difficult piece of work that has been successfully accomplished by Mr. J. R. Richardson, Chief Engineer of the steamer "Wickham," on a recent voyage from the Mediterranean to Philadelphia. Mr. Richardson's account, as published in a Philadelphia paper, is as follows:

The heavy weather and continual racing of the propeller caused the after crank pin to break in two on April 30, and at 8:30 a. m. the engines had to be stopped. We cleared the oilways of brasses and chipped the edges of the crack to keep it from tearing away the brasses. We put it together again and adjusted it very firmly, starting the engines ahead half-speed at 11:30. I had an idea of working the high pressure engine, surface condensing, and disconnecting the low-pressure engine, clamping the broken pin with its own brasses and top end bolts. During this time we had a great deal of trouble with the fore end of the shaft working forward from where it was broken, and it was liable at any time to break down the fore engine. On May 4 I discovered that it would be unsafe to longer run two engines, so I took the low-pressure slide valve out and took down the connecting rod of the after engine and clamped the pin together with the brasses so as to turn the shaft. I then fitted up the ballast donkey to act as an air pump by a suction pipe from the steam space of the condenser, and a delivery pipe into the hot well, so as to enable us to maintain a vacuum and feed the boilers with fresh water. This also enabled us to start the high pressure engine, as we had no starting valve. After this was completed we found that the ballast donkey acted as well as an air pump, and the high pressure engine started at once, on creating a vacuum. We then maintained a speed of six knots an hour.

The Westinghouse Electric & Mfg. Co.'s report states that over a year ago the company accepted a proposition of the East Pittsburg Improvement Co. to erect, according to the plans of the Westinghouse company, a new manufactory upon a site of 23 acres. In consequence of the general depression in business, the letting of the work was deferred until January, when contracts were awarded at very low rates for the erection of a two-story machine shop, 750 × 230 ft., a two-story warehouse, 750 × 75 ft., and a boiler and power house, the whole having a floor space of over ten acres. To these buildings there will be added in time a foundry, blacksmith shop and other buildings, making the whole plant, when completed, a most comprehensive one in every respect. The buildings will be of steel and brick, arranged with reference to the manufacture of modern electrical apparatus of the heaviest character, and will be equipped with electric cranes, machinery and improved machine tools. The new works will be completed and occupied during the present year.

The plan for improving the Midway Plaisance submitted by Mr. Frederick Olmsted has been accepted by the South Park Commissioners. This plan, as modified, provides for a canal 100 ft. wide up the center of the Plaisance, flanked on each side with a sidewalk, driveway and lawn, in the order named. Both the walks and driveways are to be shaded with trees, and bridges are to be constructed across the canal at Stony Island, Madison, Woodlawn, Ellis and Cottage Grove avenues. Should the Illinois Central R. R. Co., whose tracks cross the Plaisance near the east end, succeed in its intention to prevent the construction of the canal, the space provided in the plan for the waterway will be taken up with an ornamental lawn. The railway company's right of way at the point of crossing is 200 ft. wide, and the tracks are now carried on an unsightly pile trestle structure.

A new car lamp for burning gas has just been brought out by the Safety Car Heating & Lighting Co., designed especially for use in sleeping cars. The gas and oil lamps in general use on cars are supported by metal arms attached to the roof. This new lamp is attached directly to the roof and the only part of the lamp visible is the glass globe, projecting from the car ceiling. Thus the space between the upper berths on opposite sides of the car, which the gas and oil lamps heretofore in use have obstructed, is left entirely clear. Instead of using clear glass globes, a cut glass globe is used which softens the light without obstructing it as a ground glass globe would do, and makes the flame itself invisible from the interior of the car.

The bill for completing the Adirondack survey and appointing a special officer in charge has been vetoed by Gov. Flower on the ground that such work should be done under the supervision of the State Engineer.

The Louisville & Jeffersonville Bridge Co. is making arrangements to raise money for the rebuilding of the spans which fell last December. Work is to be commenced shortly in removing the wreck of the fallen spans.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago—Existing Roads.

COUDERSPORT & PORT ALLEGANEY.—Thomas Rogers, Ch. Engr., Coudersport, Pa., writes us that surveys are now being made for an extension of this road from Sweden Valley, Pa., to Ulysses, Pa., to connect with the Fall Brook line, and making an eastern outlet for this road.

FLINT & PERE MARQUETTE.—Press reports state that this company will soon commence the construction of the proposed extension from Monroe, Mich., to Toledo, O., for which the right of way has been obtained.

LOUISVILLE, EVANSVILLE & ST. LOUIS CONSOLIDATED.—Bids are asked until June 20 for excavation over roof of Patton tunnel near Taswell, Ind., and for lining 500 ft. of tunnel, as stated in our advertising columns. Ch. Engr., T. A. Allen, Evansville, Ind.

PONTIAC, OXFORD & NORTHERN.—There is talk of extending this railway to Sanilac Center, Mich.

ROCKAWAY VALLEY.—Efforts are being made at Whippany, N. J., to secure an extension of this railway from Morristown to that place, a distance of four miles.

Projects and Surveys.

BAY CREEK.—Incorporated in New Jersey to build a railway through the city of Bayonne, N. J.; capital stock, $20,000; John Wood, Camden; David Baird, Beverly; T. W. Hulme, Mount Holly, and others.

BEDFORD & BLAIR COUNTY.—A press report states as follows: The contract for building the Bedford & Blair County Ry., 42 miles long, has been awarded to E. A. Tennis, and work has already begun. This road starts at Cessna, Bedford county, Pa., and extends to Brooks Mills, in Blair county, connecting at both ends with the Pennsylvania R. R. At Osterberg it branches off into Somerset county, a distance of 18 miles, passing through thousands of acres of timber and coal lands, owned or controlled by a syndicate of lumbermen from Maine, who are also the projectors of the railroad.

BROOKLINE & MILFORD.—It is stated that the contract for building a railway between these towns in New Hampshire has been awarded to Ward Bros., Kennebunk, Me., and that the construction will be commenced at once.

INDIANAPOLIS, LOGANSPORT & CHICAGO.—Walter A. Osmer, Ch. Engr., 412 Fourth St., Logansport, Ind., writes us that this road has been located from Logansport to Indianapolis, by way of Young America, Russiaville, Kempton, Sheridan and Augusta. 71½ miles; maximum grade, 4%, and maximum curvature, 4°; light work and few bridges. Two-thirds of the right of way have been obtained and $90,000 of local aid, and negotiations are now pending for other capital for the construction. The line traverses 28 miles of the gas belt and is to be an independent road.

MAINE.—J. M. Mason, Pres. Limerick National Bank, Limerick, Me., is interested in a proposed railway from that place to Bar Mills, on the Portland & Rochester road.——Galen C. Moses, Bath, and Edward Plummer, Lisbon Falls, of the Androscoggin Water Power Co., and who have large timber interests in Byron and on the headwaters of Swift River, are reported as making a preliminary survey for a lumber railway up Swift River. The road would connect at

Rumford Falls with the Portland & Rumford Falls R. R.

PLYMOUTH COUNTY.—John F. Simmons, Pres., 54 Equitable Bldg., Boston, writes us that preliminary surveys have been made for this projected railway in Massachusetts. The route is from East Weymouth through Hingham, Hanover, Norwall, Mansfield, connecting at North Mansfield with a branch line connecting with Hanover road, a distance of 25 miles. The line is thought to offer a fine opportunity for a contractor with money to invest.

Southern—Existing Roads.

EAST TENNESSEE, VIRGINIA & GEORGIA.—This railway will be sold July 7, according to press reports, $1,500,000 being the lowest bid that will be received for the property.

HAMPTON & BRANCHVILLE.—Wm. H. Mauldin, Pres., Hampton, S. C., writes us that 16 miles of this road are in operation, the principal source of traffic being lumber. The line is projected from Hampton to Branchville, 31½ miles. Ch. Engr., W. J. Gooding, Jr.

Projects and Surveys.

ALABAMA.—It is stated that A. J. Jenkins, Letohatchie, Ala., will build a dummy road to Hayneville, a distance of five miles.

FAIRMOUNT VALLEY.—Press reports state that the construction of this road from Caryville, Tenn., northeast about 35 miles to Cumberland Gap, on the Louisville & Nashville, will be commenced at once. It is said that the scheme also embraces the construction of a road from Caryville to Kingston and Cleveland, Tenn., and Spring Hill, Ga. A.d to the amount of $400,000 has been voted.

FLORIDA.—Robt. McNamee, Leesburg, Fla., is reported as interested in a proposed railway from Leesburg to Emerald Island, 13 miles.

Northwest.—Existing Roads.

CHICAGO, ROCK ISLAND & PACIFIC.—J. W. Henderson, Fort Worth, Tex., writes us that the line was located from Fort Worth to Dallas a year ago, but that no other steps have been taken toward building the extension, and it is doubtful if the work will be done this year.

CHICAGO, ST. PAUL, MINNEAPOLIS & OMAHA.—It is stated that this company is preparing to build an extension from Bloomfield, Neb., to Fort Randall, S. Dak.

ILLINOIS CENTRAL.—Press reports state that this company will commence on June 1 the construction of a line from Le Mars, Ia., to Yankton, S. Dak.

Projects and Surveys.

QUINCY & NEW PHILADELPHIA.—Incorporated in Illinois to build a railway from Quincy, Adams county, to New Philadelphia, McDonough county; capital stock, $60,000; principal office, Industry, McDonough county, Ill.

SHEBOYGAN, ST. PAUL & CENTRAL.—The incorporation of this company was noted in our issue of May 10. A press report from Sheboygan, Wis., states as follows: The building of a new railway from this city to connect with the St. Paul system is an assured fact. At a meeting of the common council May 12 the proposition of the Sheboygan, St. Paul & Central Ry. Co. was formally accepted. The action of the council at a former meeting exacting conditions calculated to kill the prospect having been rescinded, the company will begin work at once, having the assurance of the majority of the business men that a sufficient number of signatures can be obtained to authorize the issuing of $50,000 in bonds asked by the company. It is likely that the road will eventually be extended to the southwestern part of the state, making Sheboygan the outlet for a new line of roads. The parties backing the enterprise have ample capital, the bonds required to raise the money being already placed.

Southwest.—Existing Roads.

GEORGETOWN & GRANGER.—Emzy Taylor, Pres., Georgetown, Tex., writes us that this road has been graded between Georgetown and Granges, 14¾ miles, and the track will be laid as soon as the ties and rails are secured. Capital for completing the road has not yet been obtained. Ch. Engr., R. H. Montgomery.—Press reports state that G. W. Glasscock, Georgetown, Tex., is interested in a movement to consolidate this company and the Trinity, Cameron & Western. The latter road is surveyed from Trinity to Granger, Tex., 130 miles.

MYRTLE SPRINGS SHORT LINE.—T. J. McKain, Wills Point, Tex., writes us that four miles of grading have been completed on the line from Wills Point southeast to Myrtle Springs, 8¼ miles. The line will probably be completed about Sept. 15.

SAN ANTONIO & GULF SHORE.—A correspondent writes us concerning this road, noted April 12 and May 17, that sufficient capital has been secured to complete the road and that S. Massey & Co., contractors for the entire road, will probably begin tracklaying about July 1. The line will extend from San Antonio, Tex., to Velasco, on the Gulf of Mexico, 170 miles, of which 86 miles have been located. The work is light; maximum grade of 1% and curvature of 4°. The road will be bonded for $12,000 per mile, Pres., Wm. Davis; Ch. Engr., R. H. Gresham, San Antonio.

Projects and Surveys.

RIO GRANDE NORTHERN.—G. N. Marshall, Ch. Engr., El Paso, Tex., writes us that the location of this road has been finished and that the contracts for the construction will be awarded this month. The route is from Chispa, on the Southern Pacific, to San Carlos coal mines, 27 miles. The work will be light, with two short tunnels, 300 ft. in all. There will be one 120-ft. span bridge. The principal source of traffic will be coal, and it is stated that the San Carlos Coal Co. has already contracted to supply the Southern Pacific R. R. Co. with 300,000 tons annually. Tracklaying will probably be commenced in September, and the road completed by Dec. 1, 1894.

Rocky Mt. and Pacific.—Existing Roads.

UNITED VERDE & PACIFIC.—E. H. Beckler, Jerome, Ariz., writes us that this railway is being constructed between Clear Spring, on the Santa Fe, Prescott & Phoenix, and Jerome, Ariz., 27 miles.

Projects and Surveys.

SIUSLAW & EASTERN RY. & NAVIGATION.—Isaac Britton, Gen. Man., Eugene, Ore., writes us he has been notified to make a general start June 1, which is thought to mean that everything will be ready at that date for the construction of this road. It was expected that work would be commenced this month. The route is from Florence, Ore., through Meadow, Glentana, Walton, Eugene, Springfield and east by way of Prineville, a distance of 417 miles, of which 160 miles have been located. The grades will not exceed 1% for 160 miles. There will be a 2,200-ft. tunnel, three 400-ft. truss bridges and one 500-ft. truss bridge. The right of way for the first division of 80 miles has about all been obtained and considerable aid secured. The city of Eugene gives $100,000 and 2½ miles of the right of way through city and terminals. The aim at present is to connect the timber, coal and farming lands of the Willamette Valley with the harbor of Florence, on the aPcific coast.

STREET AND ELECTRIC RAILWAYS.

BANGOR, ME.—Bonds for $300,000 are being negotiated for the construction of the proposed electric railway between this place and Stockton Springs. It is expected that the line will ultimately be extended to Rockland and to Monroe and Pushaw.

GARDNER, MASS.—The Gardner Electric St. Ry. Co. has been incorporated to construct a road 3½ miles in length; capital stock, $50,000; Treas., J. A. Stiles; Clk., M. A. Coolidge, Fitchburg.

HAMDEN, CONN.—The council has granted a franchise to the New Haven & Centerville R. R. Co. for an electric railway to Centerville.

MANCHESTER, CONN.—A survey is being made for the Manchester & Burnside Electric Ry. through the streets of this place, and it is stated the construction will be commenced as soon as the franchise is secured.

BROOKLYN, N. Y.—The Coney Island, Fort Hamilton & Brooklyn R. R. has filed amended articles of incorporation for a line from 39th St. ferry to Coney Island; capital stock, $500,000; directors, P. H. Flynn, Willis Brower and others.

CANANDAIGUA, N. Y.—The citizens have subscribed $9,000 of the $10,000 to be raised for the proposed electric street railway.

COHOES, N. Y.—A company is being formed to build an electric street railway.

CORTLAND, N. Y.—The Cortland & Homer Traction Co. has been incorporated to build an electric railway 12 miles long; capital stock, $300,000; directors, Herman Bergholtz, DeF. Van Vleet, Ithaca; H. L. Bronson and E. A. Fish, Cortland.

PHILADELPHIA, PA.—Frank L. Lyle is president of the following street railway companies incorporated May 17: North Eastern Ry. Co., capital stock, $250,000; Montgomery Ave. & Berks St. Ry. Co., capital stock, $15,000; Brown St. Ry. Co., capital stock, $18,000.——The Diamond St. Passenger Ry. Co. has been incorporated with a capital stock of $6,000; Pres., Henry C. Moore.——The street railway committee is considering 12 ordinances for new electric railways and extensions.——The Girard Ave. Passenger Ry. Co. has been incorporated with a capital stock of $9,000; directors, H. C. Moore, David Golden, Joseph C. Lugar.

BALTIMORE, MD.—Bids are asked by the City & Suburban Ry. Co., 512 Equitable Building, for broken stone for ballast for its Point Breeze extension.——It is reported that this company will probably extend its electric line from Point Breeze to Sparrow's Point.

MIDDLETOWN, MD.—The construction of an electric railway from Frederick to this place is being discussed. Pres., Geo. W. Smith, Frederick.

WASHINGTON, D. C.—Bids are asked by the District commissioners until June 7 for relaying with grooved rails a part of the Columbia Ry. tracks.——The Washington, Alexandria & Mount Vernon Electric Ry. Co. has been authorized to extend its tracks into this city.——The construction of the L St. crosstown railway is being discussed.

BENWOOD, W. VA.—Bids have been received by the Benwood, McMechen & Moundsville Electric Ry. Co. for the construction of a road 14 miles long. Pres., Col. Benjamin Wilson.

ST. AUGUSTINE, FLA.—It is reported that the St. Augustine Electric R. R. Co. is receiving bids for rails, etc., to build 4½ mues of road.

AKRON, O.—An electric railway company is reported as having been organized with a capital stock of $3,000,000 to build a road from this city to Pittsburg, Pa. Press reports state that the line is already completed from this city to Silver Gate, and is to be pushed from there to Kent, Ravenna and Youngstown, and from this point to Pittsburg. An option has been secured on the Cuyahoga River from Cuyahoga Falls to a point several miles below. There is a rapid fall in the river there and it is expected by building dams to utilize the power in running cars. General Samuel Thomas, New York, and Hon. Calvin S. Brice are among those reported as interested.

CLEVELAND, O.—The Cleveland & Akron Electric Ry. Co. has been incorporated with a capital stock of $300,000, by Martin Dodge, C. F. Dunbar, F. K. Dissette, C. W. Wood, and others. The company proposes to carry passengers, freight, express and mail.

CUYAHOGA FALLS, O.—The Akron & Cuyahoga Falls Rapid Transit Co. has been organized with a capital stock of $300,000, to construct a line from Ravenna, through Kent, this city and Akron to Barberton; directors, R. J. Randolph, E. L. Babcock, E. F. Voris, and others.

ELWOOD, IND.—A company is reported to have been organized with a capital stock of $1,000,000 for the purpose of constructing an electric railway from this city to Alexandria, Anderson and Frankton. There will be 25 miles of track and four power houses. M. S. Eringer, Indianapolis, is interested.

TERRE HAUTE, IND.—It is reported that Robert Smith and Max Joseph are trying to secure right of way for an electric railway from Harmony, passing through New England, Knightsville, Donalsonville, Morgan's Crossing, Brazil, Newburg, Staunton and Seeleyville to this city.

APPLETON, WIS.—Press reports state that the project for an electric railway between Neenah and Kaukauna, by way of this city, is being pushed by F. S. Maxwell, representing J. K. Tillotson, Toledo, O. A franchise has been secured from the town of Grand Chute, and other towns are expected to grant a similar privilege soon. The right of way has been secured for almost the entire distance, and it is hoped to have the road in operation by Jan. 1, 1895.

STILLWATER, MINN.—The Stillwater Electric Ry. Co. has been organized with a capital stock of $75,000, and will extend the present line and make additions to the rolling stock.

MARSHALL, TEX.—It is reported that a company has been formed to build an electric railway from this place to Hynson Springs, a distance of seven miles.

LOS ANGELES, CAL.—The Los Angeles, Pasadena & Altadena Electric Ry. Co. has been incorporated with a capital stock of $1,000,000; incorporators, Col. G. G. Green, Woodbury, N. J.; Andrew McNally, Chicago, Ill.; A. McNally, E. C. Haskell, and others.

SAN FRANCISCO, CAL.—The street railway lines on Third and Fourth Sts. and all the lines belonging to the Market St. Ry. Co. are reported as to be changed to electric lines.

GALT, ONT.—Contracts have been awarded by the Galt & Preston St. Ry. Co. as follows: Electrical machinery, Westinghouse Electric & Mfg. Co., at $15,925; engine and boilers, Goldie & McCulloch Co., at $6,000; construction of the track, J. Hartnett, Toronto; and for the cars to the Atlantic Ave. R. R. Co., Brooklyn, N. Y. The total cost of the road will be about $75,000. Secy. and Treas., W. H. Lutz.

ELEVATED RAILWAYS.

BROOKLYN, N. Y.—The Brooklyn & Brighton Beach R. R. Co. has been granted a franchise for extending its road by an elevated structure from Atlantic and Franklin Aves. to Fulton St., so as to connect with the Kings County Elevated R. R., and permit the running of cars direct from the Brooklyn Bridge to Coney Island without change.

HIGHWAYS.

MASSACHUSETTS.—It is proposed to construct a highway from Fitchburg to Ashby, Middlesex county.

WEATHER TABLE FOR APRIL, 1894. (Furnished to Engineering News by the Department of Agriculture.)

	Stations.	Temperature. (Deg. Fahr.) Average.	Max.	Min.	Range.	Wind. Velocity in miles per hour. Average.	Max.	Direction at time of max. velocity.	Precipitation—rain or melted snow—inches. Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities.	Northfield, Vt.	43.0	74	15	59	10.4	36	N	1.32	0.55	10
	Portland, Me.	43.2	75	19	56	9.5	31	E	2.55	0.80	12
	New York, N. Y.	49.6	76	25	51	11.3	48	NE	2.51	1.04	10
	Pittsburg, Pa.	50.9	82	24	58	6.8	30	NW	3.63	1.10	12
	Chicago, Ill.	46.8	84	31	53	13.5	52	SW	2.65	1.37	12
	Omaha, Neb.	54.0	89	29	60	9.7	32	E	2.31	0.83	12
	St. Paul, Minn.	48.7	77	26	51	8.0	36	SW	4.30	1.09	15
	Duluth, Minn.	37.8	70	23	47	6.8	27	NE	5.85	1.35	15
	Bismarck, N. Dak.	43.6	74	23	51	14.2	50	NW	3.40	0.91	14
	Average	46.4	78	24	54	10.0	38		3.17	1.00	12
Southern Cities.	Washington, D. C.	53.2	83	30	53	8.7	34	NW	3.34	1.42	10
	Louisville, Ky.	56.4	91	35	56	8.3	38	SW	3.98	1.63	12
	St. Louis, Mo.	57.8	88	34	54	10.9	49	SW	2.68	1.42	10
	Savannah, Ga.	66.3	87	44	43	9.1	29	SW	0.64	0.54	6
	Kansas City, Mo.	57.3	87	34	53	9.9	34	SW	2.51	0.94	13
	Jacksonville, Fla.	68.6	85	48	37	7.9	27	SW	0.83	0.57	4
	Chattanooga, Tenn.	61.6	88	37	51	7.8	41	W	2.00	0.71	12
	New Orleans, La.	70.8	85	55	30	8.2	30	NE	4.71	2.18	7
	Memphis, Tenn.	63.2	89	41	48	8.1	34	SW	8.45	3.29	9
	Palestine, Tex.	70.2	89	43	46	7.6	38	S	6.47	4.24	12
	Average	62.5	87	40	47	8.6	35		3.56	1.69	9.5
Western Cities.	Helena, Mont.	45.2	72	20	52	9.8	42	SW	0.82	0.45	10
	Port Angeles, Wash.	44.4	64	32	32	6.6	35	W	1.88	0.62	16
	San Francisco, Cal.	55.2	82	42	40	11.9	37	W	0.50	0.30	4
	Salt Lake City, Utah	48.1	77	30	47	6.9	37	NW	1.67	0.58	9
	Santa Fe, N. Mex.	49.0	71	25	46	8.0	38	SW	1.48	1.18	5
	Denver, Colo.	49.6	80	23	57	9.1	42	NW	3.30	1.84	6
	Yuma, Ariz.	71.2	99	42	57	8.4	42	NW	0.00	0.00	0
	Average	51.8	78	31	47	8.7	39		1.38	0.71	7

E. A. Hubbard, Ashby, is a member of the committee.——The commissioners are discussing the construction of a highway from Newburyport to Boston. Hon J. C. Bennett, Lynn, is a member of the committee.

GEORGIA.—A petition has been granted for a road in Fulton county from Peachtree road to Plaster's Bridge road. J. T. Cooper, Clk Comrs., Atlanta.

OHIO.—Bids are asked until May 31 for improving Fifth Ave. H. J. Caren, County Aud., Columbus.

MISSOURI.—The court of Jackson county has let contracts for macadamizing 12 miles of the Hickman Mills road as follows: Section 1, Collier Bros., at $9,445; sec. 2, Collier & Rice, at $12,600; sec. 3, J. Maloney, at $20,025.

OREGON.—The South Bohemian Road Co. has been incorporated at Roseberg, with a capital stock of $10,000.

CALIFORNIA.—The good roads convention, held at Los Angeles May 12, favored an issue of $750,000 in bonds for constructing roads in Los Angeles county.

BRIDGES AND TUNNELS.

BOSTON, MASS.—Wm. Jackson, Cy. Engr., has prepared plans for abolishing the grade crossings in East Boston. The estimated cost is $750,000, of which the state is to pay 25%, Boston, 10%, and the Boston & Maine and Boston & Albany railway companies, 65%.

NIAGARA FALLS, N. Y.—The Cataract Construction Co. is reported as about to build a covered stone bridge across the canal, as a conduit for its wires. The length will be over 100 ft. and cost about $12,000

WESTFIELD, N. Y.—A town meeting has been called for May 28 to vote on an appropriation of $15,000 for a new bridge on Main St.

ASBURY PARK, N. J.—The freeholders have voted to appropriate $12,000 for an iron bridge connecting this place with Interlaken. A. D. McCabe is interested.

PITTSBURG, PA.—Bids are asked until May 26 for the construction of iron and steel bridges on Elizabeth and Blaine Sts., over the Baltimore & Ohio R. R. E. M. Bigelow, Dir. Pub. Wks.

THOMASVILLE, GA.—A railway bridge over the Ochlocknee River, six miles from this place, was burned May 12.

NEW ORLEANS, LA.—The city engineer has prepared plans for an iron swinging bridge, 50 ft. clear span, across the New Orleans Navigation Canal at the intersection of Metairie road.

NATCHEZ, MISS.—The supervisors of Adams county have accepted the plans of the King Iron Bridge Co. for a steel truss bridge 270 ft. long over the St. Catherine Creek on the Washington road, and have directed the company to ask for bids for the construction, the bids to be returnable to the board July 1.

VICKSBURG, MISS.—Bids are asked until June 4 for constructing an iron bridge across Virginia Bayou, in Warren county. J. D. Laughlin, Clk. Bd. of Supervisors.

CHATTANOOGA, TENN.—The Converse Bridge Co. has been incorporated by W. H. Converse, Francis Morton, John Bogenshott and others.

COLUMBUS, O.—The governor has signed the $150,000 bond bill for a bridge over Rocky River.

DAYTON, O.—The senate has passed a bill authorizing a $15,000 bridge over the Stillwater River, near this city.

EAST LIVERPOOL, O.—The chief of engineers has ordered Lieut.-Col. Amos Stickney, Maj. D. W. Lockwood, and Capt. R. L. Hoxie, to report upon the plans for a bridge across the Ohio River at this place.

GALION, O.—The citizens have voted to issue $20,000 in bonds for a bridge over the railway tracks at East and Walnut Sts.

WALNUT HILLS, O.—The legislature has authorized the construction of the Cincinnati & Lebanon bridge at Fern St.; estimated cost, $25,000.

ASHLAND, WIS.—Bids will be asked by the county board at once, according to reports, for a new bridge across White River, in place of one recently washed away.

BURLINGTON, IA.—The Burlington & Mississippi River Bridge Co. has been incorporated with a capital stock of $600,000, to build a wagon bridge across the Mississippi River between this city and Henderson county, Ill. Incorporators, Wm. H. Fitch, E. A. Landon and H. G. Dimon, New York; S. Mellinger, A. H. Stutsman, J. Frame and G. O. Ray, Burlington.

SIOUX CITY, IA.—The Combination Bridge Co. has been incorporated with a capital stock of $2,500,000, and has absorbed the Pacific Short Line Bridge Co. It will complete the combination wagon and railway bridge across the Missouri River. Incorporators, Wm. Reynolds, Massachusetts; John Ellis, Kewanee, Ill.; D. L. Plummer, Wausau, Wis. The company has asked the city to vote a 2% tax to aid in the construction of the bridge.

ST. PAUL, MINN.—Press reports from this city state that high water in Pierce county carried away every bridge on the Rush River and undermined a 500-ft. railway bridge on the Omaha main line.

BUTTE CITY, MONT.—Bridge No. 164 on the Montana Central Ry. was burned May 11. It was nearly 000 ft. long and about 80 ft. high and spanned Dead Man's Gulch, about two miles from the depot.

HOUSTON, TEX.—G. M. La Noue, Cy. Engr., writes us that the following bids were received May 14 for the construction of the Factory St. bridge across Buffalo Bayou:

Columbus Bridge Co.,	Columbus, O.,	on stone..	$37,195
" " "	" "	" granite	37,700
Kellogg Iron Works,	Buffalo, N. Y.,	" stone..	27,100
Penn Bridge Co.,	Beaver Falls, Pa.,	" "	38,980
" " "	" "	" granite	39,900
Milwaukee Bridge & Iron Works,		" stone..	35,475
Farnsworth & Blodgett,	Kan. Cy., Mo.	" "	36,900
Mo. Val. B. & I. Wks.,	L'v'n'w'rth, Kn.	" "	37,850
Youngstown Bridge Company,		" "	36,596
Groton B. & Mfg. Co.,	Groton, N. Y.	" "	37,500
Chicago Bridge & Iron Company,		" "	40,795
King Bridge Co.,	Cleveland, O.,	" "	42,826
" " "	" "	" granite	44,124

SPRINGFIELD, MO.—The Kansas City, Fort Scott & Memphis R. R. bridge south of this city was carried away by high water May 5, and press reports state that many bridges over the James River were also carried away.

GRAHAM, TEX.—Several bridges across the Brazos River have been washed away, including one recently erected by the Chicago Bridge & Iron Co. at a cost of $13,500.

WACO, TEX.—The county commissioners have authorized the building of a bridge over the Bosque River at Mills' Crossing. It will be the longest steel bridge in the county, according to reports.——Alfred Abel, Receiver Waco & Northwestern Ry., has been authorized to erect two bridges, to cost $4,700 and $1,000.

MONCTON, N. B.—A locomotive fell through the Buctouche bridge, on the Buchtouche & Moncton Ry., May 15. The bridge is supported by five piers.

Press reports state that an unusually large number of bridges have been carried away by the recent high water, including the following: Four bridges near Dunkirk, N. Y.; two $70,000 iron bridges at Williamsport, Pa., and a $150,000 iron bridge of the Reading R. R. near that city; county and also a railway bridge at Muncy, Pa.; damage of $10,000 to Johnstown, Pa., city bridges; county bridge near Lewiston, Pa.; bridges near Dansville, N. Y.; railway bridge at Laona, N. Y., settled 2 ft.; bridges near Harrisburg, Pa.; two iron bridges at Jersey Shore, Pa.; bridges near Milton, Pa.; bridges near Chester, Pa.; county iron bridge at Mapleton, Pa.; bridges at Lebanon, Pa.; several iron bridges, including three new county bridges near Huntingdon, Pa.; total loss in Pennsylvania estimated at over $5,000,000. A large number of bridges were carried away by high water last week near Chippewa Falls, Wis.; Black River Falls, Wis.; Glenwood, Wis.; Hudson, Wis.; Roberts, Wis.; and adjacent places, causing a total loss of about $500,000 caused by the flood. The Lehigh & Hudson R. R. bridge near Buttsville, N. J., collapsed May 19, and a large wooden bridge at Mexico, Ind., May 18. One span of a railway bridge near Stuart, Neb., gave way May 9.

WATER-WORKS.

MECHANIC FALLS, ME.—The Mechanic Falls Water & Electric Light & Power Co. has been incorporated; capital stock, $7,500; Pres., A. J. Weston; Treas., J. H. DeCoster.

GROVETON, N. H.—The citizens have voted to issue $25,000 in bonds for works and surveys are now being made.

SUNCOOK, N. H.—Press reports state that Cofran, Baker & Dearborn will make important extensions this summer to the works put in last fall.

MANCHESTER, N. H.—It is stated that the citizens are undecided whether to grant a franchise or put in works.

ARLINGTON, MASS.—A town meeting will probably be held soon to consider the report of the committee; estimated cost of works, $76,000 to $9,000.

BARRE, MASS.—It is stated that works can be put in for $20,000. Engr., Mr. Marsh, of North Adams.

BLACKSTONE, MASS.—The Blackstone Water Co. has been incorporated by C. R. Day, Americus Welch, F. N. Thayer, and others to put in works; capital stock, $100,000.

IPSWICH, MASS.—Bids are asked for constructing works, including reservior, pumping station and about 10 miles of 14 to 6-in. pipe. Engr., F. C. Coffin, Exchange Bldg., Boston. E. H. Martin, Chn. Comrs.

MONSON, MASS.—The town has voted, 348 to 42, in favor of accepting the legislative act authorizing works. E. F. Morris and G. H. Newton are members of the commitee to secure plans.

ONSET, MASS.—The Onset Water Co. has leased Sturtevant Pond, in East Wareham, for a supply for Onset Bay and Point Independence. The works will include a stand-pipe. Pres., Jos. K. Nye.

ROCKPORT, MASS.—E. Worthington, Jr., & Co., Engrs., Boston, write us that the contract for pipelaying has been awarded to C. H. Eglee, Flushing, N. Y.

WORCESTER, MASS.—The commissioners are considering plans for increasing the supply, including a second reservoir; estimated cost, $200,000.

PROVIDENCE, R. I.—The aldermen have appropriated $151,000 for a system of mechanical gravity filters.

MERIDEN, CONN.—A meeting has been called for May 30 to consider an appropriation of $20,000 for replacing cement pipes with iron pipes.

RIDGEFIELD, CONN.—The Ridgefield Water Supply Co. has effected a permanent organization and will put in works, according to reports; capital stock, $50,000; Pres., E. H. Smith; Treas., C. S. Andrews, Mayor of Danbury.

FULTON, N. Y.—The citizens have adopted the report of the committee recommending a new supply at an estimated cost of $25,350 to $37,330. M. S. Northrup, Chn. Com.

GLOVERSVILLE, N. Y.—The Kingsboro Water-Works Co. has increased its capital stock from $8,000 to $16,000.

LOWVILLE, N. Y.—Bids are asked by the commissioners until May 26 for about 17 miles of pipe; June 5 for pipelaying, constructing dam, etc., and until June 20 for the construction of the reservoir. Address T. Miller Reed.

MONROE, N. Y.—Steps are being taken to secure works. Address Gilbert Carpenter.

MONTICELLO, N. Y.—Surveys for proposed works are reported as being made by John A. Miller, Goshen, N. Y.

ROCHESTER, N. Y.—The city has been authorized to issue $250,000 in bonds for extensions, and it is stated that bids will soon be asked for 30,000 ft. of 36-in. pipe.

ROME, N. Y.—The county house building committee has been instructed to employ an engineer to prepare estimates for a 60-000-bbl. reservoir.

SYLVAN BEACH, N. Y.—It is stated hat Mr. Cleveland, of Palmyra, has offered to put in works for $10,000.

TARRYTOWN, N. Y.—Bids are asked until June 1 for laying 1,300 ft. of 4-in. pipe, etc., with the right to increase the amount 200%. D. S. Merritt, Engr. and Supt.

ASBURY PARK, N. J.—Bids are asked until May 28 for $50,000 of 30-year 5% water bonds. Geo. F. Kroehl, Chn.

EGG HARBOR CITY, N. J.—The citizens are considering the question of works.

GLASSBORO, N. J.—Surveys are being made for the proposed works for this place, Clayton and Pitman.

IRVINGTON, N. J.—The council is arranging for a supply from Newark, at $125 per million gallons.

NEWTON, N. J.—An election will be held June 26 to vote on an issue of bonds for works.

WOODBRIDGE, N. J.—There is talk of a supply from Perth Amboy.

BERWICK, PA.—The Berwick Water Co. has awarded the contract for the extensions recently noted to Hite & Co., Clearfield, Pa.

GIRARD, PA.—The Girard Water Co. has been incorporated with a capital stock of $30,000; Treas., Frank May, Erie, Pa.

HARRISBURG, PA.—Bids are asked until May 30 for pipe and other supplies for one year. E. Mather, Pres. Comrs.

MANSFIELD, PA.—There is talk of extensions.

MILFORD, PA.—The Milford Water Co. has voted to increase its capital stock from $10,000 to $20,000.

BRUNSWICK, MD.—An election will be held May 28 to vote on an issue of $40,000 in bonds for works.

HAGERSTOWN, MD.—The council has voted in favor of a partial adoption of the meter system.

FORT MONROE, VA.—Bids are asked until June 16 for a 50,000-gallon water tank. Capt. John W. Pullman, Asst. Q. M., U. S. A.

RONCEVERTE, W. VA.—The council has ordered an election to vote on the question of works. H. B. Moore, Chn. Com.

AIKEN, S. C.—Henry Busch, Chn. Com., writes us that the following bids were received May 15 for constructing the proposed works:

Jas. H. Hard, Bessemer, Ala	$32,500
D. A. Thomkins Co., Charlotte, N. C	32,464
Chafee & Gardner, Augusta, Ga	30,790
R. L. Coleman, Trenton, S. C	29,000
Gude & Walker, Atlanta, Ga	28,838
C. A. Robbe, Augusta, Ga	28,000
D. L. Wardrop, Gainesville, Ga	27,981
J. W. Baum, Atlanta, Ga	26,985
Guild & White, Chattanooga, Tenn	26,010
Herbert & Lapeyre, Chattanooga, Tenn	25,850
Kelley & Davis, Atlanta, Ga	25,460
Walton & Wagner (awarded contract) Rome, Ga.	25,400

ALBANY, GA.—The council is considering the advisability of putting in an air lift pump.

MACON, GA.—T. D. Tinsley has been appointed temporary receiver of the Macon Gas Light & Water Co.

VIENNA, GA.—It is stated that an artesian supply will be secured.

MADISON, FLA.—The construction of works will soon be commenced. Engr., Col. J. F. Le Baron, Jacksonville.

QUINCY, FLA.—It is reported that a company is being organized to put in works.

COLUMBUS, MISS.—An additional supply will be secured from an artesian well, according to reports.

GRENADA, MISS.—The city is reported as wishing estimates for works. D. C. Adams, Mayor.

GREENEVILLE, TENN.—Money is being raised by subscription to commence the construction of works.

DANVILLE, KY.—Bids are asked until June 8 for constructing works, instead of May 30; specifications ready May 22. Henry E. Woolfolk, Chn. Com.

LEXINGTON, KY.—S. A. Charles, Supt., has been appointed receiver of the Lexington Hydraulic & Mfg. Co.

BELLEVUE, O.—It is stated that a new stand-pipe will be built, to cost $12,000.

DAYTON, O.—Bids are asked until May 29 for four 150-HP. boilers and until May 30 for pipelaying. C. A. Herbig, Cy. Comptroller.

MADISONVILLE, O.—The council has voted to issue $4,000 in bonds for works.

NAPOLEON, O.—The election May 15 resulted in favor of works by a vote of 538 to 93. This was the fourth election on the question, and it is stated that the construction of the works will be commenced at once; estimated cost, $60,000.

NORWOOD, O.—It is expected that an election will soon be held to vote on an issue of $50,000 in bonds for extending the system.

SALEM, O.—The council is negotiating with the water company for the purchase of the works.

AURORA, IND.—Press reports state that a franchise has been granted to an eastern firm who will soon put in works.

BORDEN, IND.—Prof. W. W. Borden is reported as planning for putting in works, at a cost of $4,000.

BRIGHTWOOD, IND.—The question of works and electric lights has been revived, according to reports.

COLUMBIA CITY, IND.—Bids are asked until June 2 for constructing works, as stated in our advertising columns. Consult. Engr., J. F. Witmer, Buffalo, N. Y. F. M. Douglas, Cy. Clk.

HAGERSTOWN, IND.—An artesian supply has been secured and there is talk of putting in works.

GRAND BLANC, MICH.—Subscriptions are being secured for a supply for fire protection.

LAKE ANN, MICH.—The citizens have voted to issue $4,000 in bonds for works.

CHICAGO, ILL.—Bids are asked until June 1 for laying water service pipes in 11 streets. H. J. Jones, Comr. Pub. Wks.

DANVILLE, ILL.—The mayor has recommended that $15,000 be appropriated, including $500 for prospecting for a supply for new works.

EDWARDSVILLE, ILL.—Jesse W. Starr, to whom a franchise for works has been granted, has incorporated the company noted last week and a mortgage for $30,000 has been given by the company to the St. Louis Trust Co.

WENONA, ILL.—It is stated that boring will be commenced soon to determine if a water supply can be obtained for works.

KENOSHA, WIS.—There is talk of a supply from driven wells.——The mayor and others have been to Fremont, Neb., to inspect the works of that city.

BELLEVUE, IA.—An election will be held May 29 to vote on an issue of $10,000 in bonds for works.

DES MOINES, IA.—Bids are asked until June 2 for furnishing 50 double-nozzle fire hydrants. John Sherman, Chn. Bd. Pub. Wks.

JEFFERSON, IA.—Plans for proposed works are being made by the U. S. Wind Engine & Pump Co., Batavia, Ill. S. C. Lee, Chn. Com.

GRAND RAPIDS, MINN.—It is stated that works to cost $20,000 will be constructed this summer.

NORTHFIELD, MINN.—The city is reported as about to issue bonds for $40,000 for works.

ST. JAMES, MINN.—The citizens have voted in favor of works and an electric light plant.

WINNEBAGO CITY, MINN.—The citizens have voted to issue $5,000 in bonds for a well and pumping station.

BEATRICE, NEB.—The mayor has vetoed the appropriation for further investigations for a supply.

FREMONT, NEB.—The council has voted to put in 12 additional hydrants and add three wells, at a cost of $6,000.

GRAND RAPIDS, NEB.—The council is considering the purchasing of a 3,000,000-gallon pump.

PENDER, NEB.—Bids are asked until June 9 for $10,000 of 20-year 6% water bonds. Geo. F. Chittenden, Clk.

CENTERVILLE, S. DAK.—The citizens have voted to issue $7,000 in bonds for works.

KIMBALL, S. DAK.—The council has ordered extensions, adding a third to the present length of the mains.

HELENA, MONT.—Bids are asked until June 9 for constructing works at Fort Harrison. Capt. Geo. S. Hoyt, U. S. A.

BRUNSWICK, MO.—Bids are asked until June 12 for constructing works, as stated in our advertising columns. Engr., P. Canfield Barney, Chillicothe, Mo. W. H. Finch, Cy. Clk.

GLASGOW, MO.—The citizens have voted to issue $6,000 in bonds for works. H. C. Cockerill, Cy. Secy.

JOPLIN, MO.—A committee has been appointed to consider the purchase of the works.

ROGERS, ARK.—The Rogers Lime & Water-Works Co. has increased its capital stock to $25,000.

HILLSBORO, TEX.—Sporger & McLeod have been awarded a contract for sinking a well 2,000 ft. deep, at $4,700, and it is stated that a company is being organized to put in works.

UVALDE, TEX.—The ice factory and water-works building has been burned; loss, $18,000.

VICTOR, COLO.—Hurd & Davis, Engrs., write us that the Victor Light, Water & Gravity Co. has been incorporated by J. E., J. B. and J. R. Downey, and that the construction of the plant has been commenced. A small pumping plant will be put in at present, the supply being from Wilson Creek.

PORTLAND, ORE.—The reception of bids for $150,000 worth of steel pipe has been indefinitely postponed, and it is probable that cast iron pipe will be used for part of the work. Isaac W. Smith, Ch. Engr.

OCEANSIDE, CAL.—The citizens have voted to issue bonds for works.

YARMOUTH, N. S.—The council has rejected the bids for a reservoir, the lowest being $14,461; engineer's estimates, $13,685.

ALYMER, QUE.—Plans for works are being made by E. J. Bainboth.

BRACEBRIDGE, ONT.—Bids are asked until June 11 for constructing works. Engr., W. C. Brough, 61 Victoria St., Toronto.

BROCKVILLE, ONT.—A meeting was held last week to consider the question of raising $75,000 for works and sewers.

VICTORIA, B. C.—Bids are asked until July 3 for about 310 tons of pipe and 3¼ tons of special castings. W. J. Dowler, City Clerk's Office.

ARTESIAN WELLS.

FOND DU LAC, WIS.—It is stated that an artesian well will be sunk on the grounds of the kite track.

MONROE, WIS.—The water-works company is reported as arranging for sinking a well 2,000 ft. deep.

PIERRE, S. DAK.—The committee to secure an artesian well has elected D. W. Robinson president and L. B. Albright secretary.

IRRIGATION.

NORTH PLATTE, NEB.—It is stated that 150 miles of irrigation ditches are under construction in this county, and that others are contemplated.

PASCO, WASH.—Theodore Newcomb, Brooklyn, N. Y., is reported as interested in a scheme to take the water of the Snake River, by means of wheels and pumps, near this place to irrigate 8,000 to 10,000 acres.

NEW COMPANIES.—Cross-Cut Ditch Co., Greeley, Colo.; $5,000; U. M. Henderson, F. F. DeRush, O. J. White.——Jackson Ditch Co., Denver, Colo.; $2,400; L. B. Taft, H. B. Newton, George Stearly.——Montpelier Irrigation & Mfg. Co., Montpelier, Idaho; $5,000; W. W. Clark, W. Hoganson, David Osborn.——Cheyenne Land & Canal Co., Kit Carson, Colo.; $10,000; E. P. Slattery, G. B. Slattery, J. M. Peterson.——Collins Reservoir, Drain & Irrigation Co., Fort Collins, Colo.; $600.

SEWERS.

ROCHESTER, N. H.—Surveys are being made for the completion of the system. Engr., Ernest W. Bowditch, Boston.

MIDDLEBURY, VT.—Plans for a system of sewers are being made by A. L. Webster, New York, according to reports.

VERGENNES, VT.—Surveys for a sewer in Main St. have been made by H. M. McIntosh, Cy. Engr., Burlington.

HALLOWELL, MASS.—The council has ordered the construction of a sewer in Winthrop St.

NEW HAVEN, CONN.—The council has voted to issue $100,000 in bonds for sewers.

BAINBRIDGE, N. Y.—This place is discussing the construction of a sewer system.

BUFFALO, N. Y.—Bids are asked by the department of public works until May 30 for constructing 20 to 12-in. tile sewers in two streets.

KINGSTON, N. Y.—The committee has been directed to report an ordinance for sewers in Wards 2 and 9.

LIBERTY, N. Y.—The "Register" urges that steps be taken towards securing a system.

NEW YORK, N. Y.—Bids are asked by the department of public works until May 28 for altering and constructing sewers in seven streets.

NYACK, N. Y.—Plans made by Jas. S. Haring, Suffern, for the proposed system have been approved by the board of health.

ROCHESTER, N. Y.—Bids are asked until June 1 for constructing pipe sewers in two streets. Thos. J. Neville, Cy. Clk.——The lowest bid for the construction of the Thomas St. outlet sewer was that of H. N. Cowles at $21,420; estimated cost, $25,100.

SENECA FALLS, N. Y.—Bids are asked by the street committee for the construction of a sewer in Walnut St.

SYRACUSE, N. Y.—The report of S. M. Gray, Providence, R. I., recommends the adoption of the combined system except in the Twelfth Ward district and such upper portions of districts as do not require the removal of storm water by sewers. These areas may be sewered on the modified separate system.

WOODBURY, N. J.—Plans have been made by several engineers for the proposed system, according to reports; estimated cost, $40,000 to $55,000.

CONSHOHOCKEN, PA.—There is talk of a system.

GREENSBURG, PA.—The committee has recommended the construction of a system in Ward 5.

NEW CASTLE, PA.—Bids are asked until May 26 for the construction of a sewer in Mercer St. Frank Tidball, Cy. Clk.

PITTSBURG, PA.—Ordinances have been passed for 15-in. sewers in five streets.

CHARLOTTESVILLE, VA.—The council has ordered the sale of bonds for sewer purposes, and it is probable that the construction will soon be commenced.

PALATKA, FLA.—There is talk of bonding the city for $60,000 for sewers and for paving streets.

CLEVELAND, O.—Bids are asked until June 13 for constructing sewers in three streets. J. H. Farley, Dir. Pub. Wks.

MARIETTA, O.—The committee has asked authority to issue bonds for $15,000 for sewers.

TERRE HAUTE, IND.—Bids are asked until June 5 for 10-in. pipe sewers in four streets. C. H. Goodwin, Cy. Clk.

JACKSON, MICH.—The citizens are considering the construction of sewers, estimated to cost $50,000 to $75,000.

CHAMPAIGN, ILL.—The engineer has completed plans for the proposed system for this place and Urbana, and it is reported that the work will soon be commenced.

APPLETON, WIS.—The council is discussing an extension of the sewer system, estimated to cost $13,020.

WATERTOWN, WIS.—It is reported that bids will soon be asked for extending the system.

DAVENPORT, IA.—Bids are asked until June 2 for constructing about 3,000 lin. ft. of sewers. Thos. Murray, Cy. Engr.

LE MARS, IA.—The following bids were received for the construction of 28,538 ft. of 22 to 8-in. sewers:

D. M. Linihan, Dubuque	$17,630
E. M. Kringle, Dubuque	17,180
Edward Blake, Dubuque	22,226
F. Stinson, Council Bluffs	16,589
Wright & Fleming, Des Moines	19,121
Thos. Dorsey & M. R. Hogan, Dubuque	25,490
Chas. E. Savenell & N. A. Peterson, Sioux City	15,721
W. T. Johnson, E. O. Wesley & J. W. Smith	14,142
C. J. Johnson & Fred Yarrington, Minneapolis	20,374
J. L. Black, Omaha	16,008
John Lindquist, St. Paul	16,748
J. C. Danforth & P. Peterson, W. Bay City, Mich	15,030
Sioux Cy. Stm. Pmbg. & Mill Sup. Co., Sioux Cy.	13,539
W. H. Massey, Sioux City	15,879
Dubuque Construction Co., Dubuque	15,691
J. A. Barris & Co., Council Bluffs	20,431
Murray Bros., Cedar Rapids	18,582
Bennett & McCauley, Des Moines	19,433
Hannett & McDonald, Omaha	15,337
G. A. Steinbeck & John Fossberg, Sioux City	15,903
Geo. R. King & Co., Duluth	19,757
D. E. & E. A. Whitcomb, Council Bluffs	19,215
E. J. Hanlon, Sioux City	14,583
Goodrich & Robson, Sioux City	15,773
Jackson & Moos, Fort Madison	19,646
Stevenson, Reid & Co., Port Huron, Mich	17,347

The contract has not yet been awarded pending a decision as to the legality of the work.

LYONS, IA.—The city engineer is making surveys for about 1½ miles of sewers.

YORK, NEB.—The mayor has suggested that the council take steps towards the construction of a system.

HELENA, MONT.—Bids are asked until June 9 for constructing 11,000 ft. of pipe sewers at Fort Harrison. Capt. G. S. Hoyt, U. S. A.

ST. JOSEPH, MO.—The council has adopted ordinances for constructing sewers in two streets.

WACO, TEX.—The council has ordered the construction of 66,200 lin. ft. of 15 to 8-in. sewers; estimated cost, $29,305.

LOS ANGELES, CAL.—Plans are being prepared for sewers in the western part of the city.

SACRAMENTO, CAL.—Bids are asked by the city clerk until June 14 for plans and specifications for a sewerage system. Premiums of $500 and $200 will be given.

SANTA MONICA, CAL.—The board of trade is discussing the sewerage question. There is talk of issuing bonds.

PETERBORO, ONT.—The sewer committee has reported that an 18-in. pipe outfall sewer in George St. would cost about $20,000. H. Best, Chn. Com.

STREETS.

BOSTON, MASS.—The board of aldermen has voted to petition the legislature for authority to issue $800,000 in bonds for the extension of Columbus Ave.——The board of street commissioners has recommended the improvement and extension of five streets at an estimated cost of about $797,852.

PASCOAG, R. I.—It is stated that authority will be asked to issue $50,000 in bonds for street improvements.

PROVIDENCE, R. I.—The committee on highways has decided to recommend the use of Trinidad Lake asphalt for paving the streets of the city.

BROOKLYN, N. Y.—Bids are asked until May 29 for paving one street with cobblestones and flagging sidewalks in four streets; and also until June 1 for grading and paving two streets with granite. A. T. White, Comr. Pub. Wks.

GLOVERSVILLE, N. Y.—Bids are asked until June 11 for 16,200 sq. yds. of paving with brick or asphalt, as stated in our advertising columns. E. Brown Baker, Cy. Engr.

HORNELLSVILLE, N. Y.—The council has voted to pave three streets with brick at an estimated cost of $100,000.

NEW YORK, N. Y.—Bids are asked by the department of public works until May 28 for grading and improving six streets.

OWEGO, N. Y.—It is reported that about $4,000 will be expended in paving Lake St.

ROCHESTER, N. Y.—The following bids were received for paving State St. with Medina stone: Whitmore, Rauber & Vicinus, $41,758; Bruff, Horn & Co., $42,139; Gilbert, Brady & Co., $42,387; Chambers & Casey, $42,650; Brayer & Albaugh, $43,983; Rock Asphalt Pavement Co., $44,092; Lauer & Hagaman, $46,290; H. N. Cowles, $47,149; William H. Jones & Sons, $50,577; engineer's estimate, $57,000.——The city surveyor is preparing an estimate for paving Culver St. with trap rock.

SALAMANCA, N. Y.—The citizens have voted to pave 987 ft. on Main St., to cost about $7,500, and the work will probably soon be commenced.

SARATOGA SPRINGS, N. Y.—Cramer & Eldridge have been directed to prepare plans for about 1,500 sq. yds. of brick paving on concrete.

TROY, N. Y.—Bids are asked until May 29 for paving Front St. with granite blocks. E. O. Ross, Secy. Pub. Wks.——Ordinances have been passed for paving three streets with brick and two with granite.——The city engineer has been directed to prepare plans for improving several streets.

YONKERS, N. Y.—The mayor has recommended the immediate macadamizing of Yonkers Ave.

ASBURY PARK, N. J.—An ordinance has been adopted for grading and graveling Third Ave. P. N. Black, Engr.

JERSEY CITY, N. J.—Bids are asked until May 28 for paving 3,750 sq. yds. with asphalt. G. T. Bouton, Clk. St. Com.

ALLENTOWN, PA.—Robert Rathburn, Cy. Engr., is reported as investigating the cost of paving the streets with brick.

BELLEVUE, PA.—Bids are asked until May 31 for grading and paving Sprague Ave. J. M. Simeral, Secy. of Council.

BRADFORD, PA.—The city engineer has been directed to prepare plans for paving Corydon St. There is talk of paving Forman St. with brick.

NEWCASTLE, PA.—J. H. Miller, Cy. Engr., informs us that the bids for paving 13,444 sq. yds. in Jefferson St. and 18,832 sq. yds. in Mill St. with Park brick was as follows:

	Jefferson St.	Mill St.
J. C. McSpadden	$24,224	$36,431
Park Paving Co.	20,954	31,719
Davis & Caldwell	23,028	34,707
Erbeck Bros.	19,906	30,639
W. B. Connell	22,534	33,973
E. M. Ayers	16,506	25,230
Barnett & Dodge	19,782	31,815
P. T. McCourt	22,781	33,214
Mitchell Bros.	24,948	.....
J. W. Kelly	23,773	.....
McMillin & Moorhead	.....	33,533

The contract for both streets was awarded to E. M. Ayers for one course of brick to be laid upon 6 ins. of concrete and granite, grouted with Portland and hydraulic cement in proportions of 1 to 4. The contract for paving 1,847 sq. yds. in Neshamock Ave. with asphalt blocks upon gravel foundation was awarded to A. V. Purnell, at $3,694.

PHILADELPHIA, PA.—Bids are asked until May 29 for grading, macadamizing and repairing several streets. J. H. Windrim, Dir. Dept. Pub. Wks.

PITTSBURG, PA.—The council has adopted ordinances for grading and paving three streets with asphalt. W. C. Gearing, Cy. Clk.

RIDGWAY, PA.—It is reported that there is talk of paving the streets with brick.

WILKINSBURG, PA.—The council is discussing an ordinance to issue $100,000 in bonds for street improvements.

BRUNSWICK, MD.—An election is to be held May 28 to decide on issuing $10,000 in bonds for street improvements.

RALEIGH, N. C.—An election is to be held Aug. 6 to vote on issuing $50,000 in street improvement bonds.

PALATKA, FLA.—The bonding of this place for $60,000 to pave streets and build sewers is being agitated.

MONTGOMERY, ALA.—The contracts for paving Dexter Ave. and other streets with brick have been awarded to the Southern Construction Co., at $49,089. The bids were published in our issue of May 3.

NEW ORLEANS, LA.—It is proposed to pave 25 streets with gravel.

HENDERSON, KY.—An ordinance has been adopted to grade and pave Center St. with brick. J. C. Thomasson, Cy. Clk.

AVONDALE, O.—Bids are asked until May 28 for

the sale of $10,000 in bonds for paving. W. E. Wynne, Clk.

BELLEFONTAINE, O.—Bids are asked until June 2 for paving in two streets. S. M. Stamats, Clk.

BELLEVUE, O.—Plans are being prepared for paving Southwest St., according to reports.

BOND HILL, O.—Bids are asked until June 4 and 11 for grading one street at each date. W. H. Brickel, Jr., Village Clk.

CINCINNATI, O.—Bids are asked by the board of administration until June 12 for grading and improving Madisonville Ave., and until June 2 for grading and paving two streets with brick.

DAYTON, O.—Bids are asked until June 4 for paving a street with either Medina blocks, asphalt or brick. C. A. Herbig, Cy. Comptroller.

DETROIT, MICH.—The secretary of the boulevard commission has been directed to advertise for bids for paving part of the boulevard.

FOSTORIA, O.—Bids are asked until June 5 for paving several streets with brick. J. M. Schatzel, Cy. Clk.

MARION, O.—The city has voted to issue $100,000 in bonds for paving.

INDIANAPOLIS, IND.—The board of public works has voted to pave 6,204 ft. in West Washington St. with brick, for which bids will soon be asked.

SOUTH BEND, IND.—The St. Joseph Paving & Sewer Co. has been incorporated by Samuel Leeper, James Nelson and C. H. Defrees; capital stock, $3,000.

KALMAZOO, MICH.—The paving of Pitcher and Porter Sts. with brick is being agitated.

MONROE, MICH.—The city clerk has been authorized to advertise for bids for the cleaning of paved streets and the construction of sidewalks.

BELLEVILLE, ILL.—Bids are asked until June 2 for paving Main St. with brick, as stated in our advertising columns. F. W. Purderer, Cy. Clk.

BERWYN, COOK CO., ILL.—It is proposed to macadamize 10 miles of streets this summer, at an estimated cost of about $200,000.

CHICAGO, ILL.—Bids are asked until May 31 for laying private drains in 14 streets. H. J. Jones, Comr. Pub. Wks.——The Star Paving Co. has been incorporated with a capital stock of $20,000, by Joseph Schensowky, Albert Meysel, Max A. Dornblatt.——The Eureka Paving Co. has been incorporated with a capital stock of $5,000, by Wm. O. Oppenheim, F. W. Hammell, and J. H. Stevens.

ROCK ISLAND, ILL.—The contract for paving the first two sections of 17th St. has been awarded to Edwards & Walsh Construction Co., at $19,000, Rock Island brick and Bearea sandstone to be used.

VENICE, ILL.—The village clerk has been directed to advertise for bids for macadamizing the Edwardsville road.

MILWAUKEE, WIS.—Bids are asked until May 29 for grading and paving 21 streets with cedar blocks, gravel, or granite. G. H. Benzenberg, Cy. Engr.

RACINE, WIS.—The paving of Main St., West Sixth St., Park Ave. and Junction Ave. is being agitated. It would cost about $61,000 to pave Main St. with asphalt, or $26,700 with cedar blocks.

DAVENPORT, IA.—Bids are asked until June 2 for paving 3,822 lin. ft. with brick. Thos Murray, Cy. Engr.

DES MOINES, IA.—Bids are asked by the board of public works until June 2 for paving five streets with brick on concrete.

BUTTE CITY, MONT.—The mayor has recommended that steps be taken at once to pave three streets, for which surveys and estimates have been made.

EXCELSIOR SPRINGS, MO.—A committee has been appointed to investigate the cost of macadamizing or paving the streets with brick.

ST. LOUIS, MO.—Bids are asked by the board of public improvement until June 12 for improving 22 streets, and until June 19 for 24 alleys; also until June 5 for delivering macadam and constructing and repairing sidewalks.

MONTREAL, QUE.—The road committee has estimated the cost of paving St. James St. with asphalt at $24,000; paving 12 streets with block stone, at about $169,000.

HAMILTON, ONT.—The city engineer has estimated the cost of paving three streets with asphalt at about $156,255; with brick, $138,463; tar asphalt, $102,287; composite asphalt on sides and brick in center, $151,404.

WINNIPEG, MAN.—The committee has recommended that Fort St. be paved with cedar blocks, at an estimated cost of $12,800; that 8½ miles of streets be gravelled, estimated cost, about $44,000; and about 3½ miles be macadamized, at a cost of about $46,000.

ELECTRIC LIGHT AND POWER.

MANVILLE, R. I.—The Manville Electric Light & Power Co. has petitioned for authority to put in a plant.

MIDDLETOWN, CONN.—The Schuyler Electric Light Co. is being organized with a capital of $150,000 for the purpose of erecting a plant, according to reports.

BLAKELY, PA.—W. W. Paterson, of the New York & Scranton Coal Co., has proposed to the council to put in an electric light plant to cost $10,000, the borough to buy half the stock and the citizens the balance.

MONTROSE, PA.—A committee has been appointed to investigate the question of an electric light plant.

GRENADA, MISS.—It is reported that this place is discussing the erection of an electric light plant. D. C. Adams, Mayor.

MADISONVILLE, O.—The council has voted to issue $6,000 in bonds for electric lights.

MARTIN'S FERRY, O.—The citizens will vote on issuing $30,000 in bonds for the re-erection of the electric light plant that was burned.

IMLAY CITY, MICH.—It is reported that this place is considering putting in an electric light plant.

RACINE, WIS.—The council has voted to readvertise for bids for street lighting.

CENTERVILLE, S. DAK.—It is reported that a company is being organized to put in an electric light plant.

BUTTE CITY, MONT.—The Phoenix Electric Light & Steam Heating Co. has petitioned the council for a franchise for an electric plant.

BRUNSWICK, MO.—Bids are asked until June 12 for the construction of an electric light plant, as stated in our advertising columns. Consult. Engr., P. Canfield Barney, Chillicothe, Mo. W. H. Finch, Cy. Clk.

VICTOR, COLO.—The Victor Light, Water & Gravity Co., recently incorporated, has commenced the construction of its plant. Hurd & Davis, Engrs.

MEDFORD, ORE.—The council has granted an electric light franchise to John C. Baird, Portland. There will be 300 incandescent and a number of arc lights, and it is also proposed to extend the service to Jacksonville.

NEW COMPANIES.—Fletcher & Fletcher Electric Co., Cleveland, O.; $10,000; H. S. Gray, J. W. Monroe, G. B. Riley.——Consolidated Electric Improvement Co., Camden, N. J.; $100,000; Peter E. Costello, Tacony; James Franklin, 500 Chestnut St., Philadelphia, Pa.; T. P. Curley, Camden.——Union Light & Power Co., Nashville, Tenn.; Pres., J. D. Harvey; Secy. and Treas., Thomas Taylor.——Illinois Electrical Reminder Co., Chicago, Ill.; $25,000; W. Clyde Jones, G. L. Cragg.——Van Choate Electric Co., Portland, Me.; Pres., S. F. Van Choate, Boston; Treas., W. L. Knox, Winchester.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

FIREBOAT.—Cleveland, O.—Bids are asked until June 13 for a wood, steel, or iron fireboat 88 ft. long with 22-ft. beam. H. H. Hyman, Dir. Fire Service.

DAM.—Brunswick, Me.—The Brunswick end of the Pejepscot Paper Co.'s dam at Jack's Crossing, four miles below Lisbon Falls, on the Androscoggin River, has been carried away.

DEEPENING OF RIVER.—London, Ont.—Bids are asked until June 2 for deepening the Maitland River, Hullett township; estimated cost, $9,500. F. N. Farncomb, Engr., 213 Dundas St.

GAS IMPROVEMENTS.—Brooklyn, N. Y.—The Coney Island Fuel, Gas & Light Co. is preparing to build a new storage tank of a capacity of 150,000 cu. ft. and to make other improvements, at a cost of $150,000.

BONDS.—Brooklyn, N. Y.—Bids are asked by the city controller until May 29 for the purchase of $550,000 of 4% bonds, as follows: $150,000 for school buildings, and $100,000 each for sewerage, local improvements, parks and bridges.

Faribault, Minn.—Bids are asked until June 16 for the purchase of $25,000 of 10-year 4½% municipal bonds. B. B. Sheffield, Mayor.

College Point, N. Y.—The board of education has been authorized to issue bonds for $50,000 for a new school building.

Janesville, Wis.—It is stated that $50,000 in bonds will be issued for a new school building.

Bad Axe, Mich.—The city has sold $6,000 of school bonds for $6,100.

CONDENSED LIST OF CONTRACTS PENDING, WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
May 25.	Water-works system, Dolgeville, N. Y. Advertised, Eng. News, May 10.		May 10
May 25.	Pipe sewer (24-in.)	Elizabeth, N. J.	May 10
May 25.	Brick paving, Pekin, Ill. Advertised, Eng. News, May 10.		May 10
May 25.	Pipe sewers (6¾ m.), Advertised, Eng. News, May 17.	Winchester, Mass.	May 17
May 25.	Paving brick, etc.,	Portsmouth, Va.	May 17
May 25.	Macadam. (11,000 lin.ft.),	Columbus, O.	May 17
May 25.	Storm water sewer,	Dayton, O.	May 17
May 25.	Electric light plant,	Hawarden, Ia.	May 17
May 26.	Bridges and approaches,	Cincinnati, O.	May 10
May 26.	Grading 11th Ave.,	Altoona, Pa.	May 17
May 26.	Railway (6 miles),	Petersburg, Va.	May 17
May 26.	Water-works,	Milford Centre, O.	May 17
May 26.	Electric light plant,	Milford Centre, O.	May 17
May 26.	Pipe (17 miles),	Lowville, N. Y.	May 24
May 26.	Sewer,	New Castle, Pa.	May 24
May 26.	Bridges,	Pittsburg, Pa.	May 24
May 28.	Improv'g Harvey Ave.,	Avondale, O.	May 10
May 28.	Paving (37,000 sq.yds.),	Dayton, O.	May 3
May 28.	Water supply, Advertised, Eng. News, May 10 and 17.	M. Hospl., N. Orleans, La.	May 19
May 28.	Steel bridge,	Bryan, O.	May 17
May 28.	Bridge,	Brantford, Ont.	May 17
May 28.	Water-wks franchise, Advertised, Eng. News, May 17 and 24.	Alexandria, Ind.	May 17
May 28.	Street imp'v'ts,	New York, N. Y.	May 24
May 28.	Sewers,	New York, N. Y.	May 24
May 28.	Water bonds,	Asbury Park, N. J.	May 24
May 28.	Asphalt paving,	Jersey City, N. J.	May 24
May 28.	Paving bonds,	Avondale, O.	May 24
May 29.	P'p'g engs., st'd-pipe, Advertised, Eng. News, May 17 and 24.	Youngstown, O.	May 17
May 29.	Excav., masonry, etc.,	St. Louis, Mo.	May 17
May 29.	Iron pipe (60-in.), etc.,	St. Louis, Mo.	May 17
May 29.	Cobblestone paving,	Brooklyn, N. Y.	May 24
May 29.	Bonds,	Brooklyn, N. Y.	May 24
May 29.	Granite block paving,	Troy, N. Y.	May 24
May 29.	Boilers (4),	Dayton, O.	May 24
May 29.	Cedar block paving,	Milwaukee, Wis.	May 24
May 30.	Sewer,	Waterbury, Conn.	May 17
May 30.	Pipe, etc.,	Harrisburg, Pa.	May 24
May 30.	Pipelaying,	Dayton, O.	May 24
May 31.	Paving (19,955 sq.yds.), Advertised, Eng. News, May 17 and 24.	Dunkirk, N.Y.	May 17
May 31.	Sidewalks during '94,	Sandusky, O.	May 17
May 31.	County road bonds,	Alpena, Mich.	May 17
May 31.	Water-works system, Advertised, Eng. News, May 17 and 24.	Tipton, Ind.	May 17
May 31.	Paving,	Bellevue, Pa.	May 24
May 31.	Highway,	Columbus, O.	May 24
May 31.	Private drains,	Chicago, Ill.	May 24
June 1.	Electric lighting,	Jackson, Tenn.	April 26
June 1.	Sewer (9,500 lin.ft.), Advertised, Eng. News, May 17 and 24.	Frankfort, Ind.	May 10
June 1.	Elevator, Gov't Bldg., Advertised, Eng. News, May 10 and 17.	Galveston, Tex.	
June 1.	W.-w'ks bonds,	E. Cottage Grove, Ore.	May 10
June 1.	Water-works system, Advertised, Eng. News, May 17 and 24.	Farmington, Ill.	May 17
June 1.	Granite block paving,	Brooklyn, N. Y.	May 24
June 1.	Pipe sewers,	Rochester, N. Y.	May 24
June 1.	Pipelaying,	Tarrytown, N. Y.	May 24
June 1.	Water service pipes,	Chicago, Ill.	May 24
June 2.	Elec. l't and p'p'g pl't,	Newberry, Mich.	May 10
June 2.	Iron h'way bridge,	Kansas City, Kan.	May 17
June 2.	Water-whl. and pump, Advertised, Eng. News, May 17 and 24.	Freehold, N.J.	May 17
June 2.	Water-works, Advertised, Eng. News, May 24 and 31.	Columbia City, Ind.	May 24
June 2.	Brick paving,	Cincinnati, O.	May 24
June 2.	Brick paving, Advertised, Eng. News, May 24.	Belleville, Ill.	May 24
June 2.	Brick paving,	Davenport, Ia.	May 24
June 2.	Sewer,	Davenport, Ia.	May 24
June 2.	Brick paving,	Des Moines, Ia.	May 24
June 2.	Fire hydrants (50),	Des Moines, Ia.	May 24
June 2.	River deepening,	London, Ont.	May 24
June 4.	Bridges, dur'g '94,	Fort. Madison, Ia.	May 3
June 4.	Bridge,	Vicksburg, Miss.	May 24
June 4.	Grading, Bond Hill,	O.	May 24
June 4.	Paving,	Dayton, O.	May 24
June 5.	Government bldg., Advertised, Eng. News, May 10 and 17.	Haverhill, Mass.	
June 5.	Iron wk., etc.,	Univ. bldg., Cincinnati, O.	May 10
June 5.	Supplies, War Dept., Advertised, Eng. News, May 17.	Washington, D.C.	
June 5.	Water-w'ks system,	Hutchinson, Minn.	May 17
June 5.	Irrigation bonds,	Ellensburg, Wash.	May 17
June 5.	Pipelaying (17 miles),	Lowville, N. Y.	May 24
June 5.	Brick paving,	Fostoria, O.	May 24
June 5.	Sewers,	Terre Haute, Ind.	May 24
June 5.	Macadamizing,	St. Louis, Mo.	May 24
June 6.	Water-works system, Advertised, Eng. News, May 17.	Penn Yan, N.Y.	May 17
June 7.	Relaying St. Ry. track,	Washington, D.C.	May 24
June 8.	Water-works system, Advertised, Eng. News, May 3 to 24.	Danville, Ky.	May 24
June 9.	Water-w'ks and sewers,	Helena, Mont.	May 24
June 9.	Water-works bonds,	Pender, Neb.	May 24
June 11.	Ft. Harrison, U.S.A.,	Helena, Mont.	May 17
June 11.	Paving, Advertised, Eng. News, May 24 and 31.	Gloversville, N. Y.	May 24
June 11.	Grading, Bond Hill,	O.	May 24
June 12.	Asphalt paving,	Schenectady, N. Y.	May 10
June 12.	Street improvements,	Cincinnati, O.	May 24
June 12.	Street improvem'ts (22),	St. Louis, Mo.	May 24
June 12.	Water-works system, Advertised, Eng. News, May 24 to June 7.	Brunswick, Mo.	May 24
June 12.	Electric light plant, Advertised, Eng. News, May 24 to June 7.	Brunswick, Mo.	May 24
June 13.	Iron bridge spans, Advertised, Eng. News, May 3 to June 7.	Hawkinsville, Ga.	May 3
June 13.	Sewers,	Cleveland, O.	May 24
June 13.	Fireboat,	Cleveland, O.	May 24
June 14.	Water-works system, Advertised, Eng. News, May 17 and 24.	Norfolk, Conn.	May 17
June 14.	Sewer plans,	Sacramento, Cal.	May 24
June 16.	Water tank,	Fort Monroe, Va.	May 24
June 16.	Bonds,	Faribault, Minn.	May 24
June 18.	Highway,	Little Rock, Ark.	May 17
June 19.	Alley improvem'ts (24),	St. Louis, Mo.	May 24
June 20.	Railway excavation, Advertised, Eng. News, May 24 to June 14.	Evansville, Ind.	May 24
June 20.	Lining tunnel, Advertised, Eng. News, May 24 to June 14.	Evansville, Ind.	May 24
June 20.	Reservoir,	Lowville, N. Y.	May 24
June 26.	Water-works bonds,	Danville, Ky.	May 17
———	Water-works franchise, Advertised, Eng. News, May 10 to 31.	Florence, N.C.	May 10
———	Water-works bonds,	Hoquiam, Wash.	May 17
July 3.	Pipe,	Victoria, B. C.	May 24
———	Water-works system,	Ipswich, Mass.	May 24
———	Sewer,	Seneca Falls, N. Y.	May 24
———	Bridge,	Natchez, Miss.	May 24
———	Stone ballast,	Baltimore, Md.	May 24

CONTRACT PRICES.

MANHOLE CASTINGS.—Winchester, Mass.—Ernest W. Bowditch, Engr., Boston, informs us that the bids for 132 sets of manhole castings ranged from $5.70 to $10.50 per set.

MACADAMIZING.—Allentown, Pa.—L. J. H. Grossart, Engr., writes us that contracts for macadamizing two streets have been awarded to N. E. Crilly, at $1.08 and $1.50 per ft.

WATER-WORKS SUPPLIES.—South Bend, Ind.—Contracts have been awarded as follows: 353 tons of pipe, Lake Shore Foundry Co., $16.95 per ton; special castings, 2 cts. per lb.; Matthews' hydrants, R. D. Wood & Co., $23.50 each; p'g lead, H. P. Blair & Co., 3.4 cts. per lb. Last year the city paid $24.50 per ton for pipe, and $26 each for Matthews' hydrants. The bids for valves ranged as follows: 6-in., $9 to $13.84; 8-in., $15 to $20.50; 12-in., $20.50 to $42.40.

PIPE.—Boston., Mass.—W. E. Swan, Secy., writes us that the water board has awarded the contract for 85 tons of 48-in. pipe and 56 tons of special castings for dam No. 5, to the McNeal Pipe & Foundry Co., at $21.15 and $41.90 per ton of 2,240 lbs., respectively, f. o. b. cars at South Framingham, Mass. R. D. Wood & Co. bid $20.90 and $47.

Youngstown, O.—Press reports state that the lowest bid for 1,000 tons of 24 to 16-in. pipe was that of the Addyston Pipe & Steel Co., at $16.65, and that the city paid $21.75 per ton for similar pipe last year.

CRUSHED STONE.—Allentown, Pa.—The council has awarded a contract for a supply of crushed stone to Geo. Clader & Bro., at $1.04½ cts. per ton for mountain stone, the bid for other stone being 91 cts. for limestone and $1.15 for granite. A. M. Stephens bid 89 cts. for limestone and $1.10 for granite; M. E. Egan, 75 cts. for limestone, and Reinhard & Weaver, 98 cts. for limestone. L. J. H. Grossart, Engr.

Milwaukee, Wis.—A contract for nearly 2,000 tons of crushed stone for repairing streets has been awarded at $1.17 and $1.27 per cu. yd.

PAVING BRICK.—Wilmington, Del.—The following bids have been received for 23,400 sq. yds. of paving brick: W. B. Stratton, Empire, O., 88 to 90 cts. per sq. yd.; S. S. Sexton, Canton, $1.03 to $1.13; John C. Bolen, Zanesville, O., $1.03, $1.05; W. J. Dollanson, Philadelphia, $1.06; Interstate Paving Brick Co., Philadelphia, 90 cts., 95 cts.; George H. McCall Co., Wilmington, 90 cts.; State Line Fire Brick Co., $1.13½; Monongahela Fire Brick Co., $1.03, $1.08; McMahon, Porter & Co., New Cumberand, W. Va., $1.07; Kuntz & Co., Philadelphia, $1.01; W. F. Robinson & Co., Wilmington, $1.11, $1.17; Mack Mfg. Co., $1 to $1.15; Charles Warner Co., $1.05 to $1.08; National Lumber & Shipping Co., $1.18¼, $1.05¼.

SEWERS.—Boston, Mass.—The metropolitan sewerage commission has received the following bids:

	Sec. 11.	Sec. 31.	Sec. 32.
Nat'l Const'n Co., Boston	$36,380	$47,987	$48,784
E. F. Brigham, W. Medford	32,058	.....	.....
J. N. Drew & Co., Malden	24,954	.....	.....
Jones & Meehan, Jamaica Plain	21,158	46,321	51,570
Chas. Linehan, Cambridgeport	20,537	.....	.....
Met'p'n Const'n Co., Boston	.....	40,398	40,776
Lindsey & Cudmore, Somerville	.....	41,688	.....
Fallon & Cronin, Roxbury	.....	47,900	46,713
Dennis O'Connell, Dorchester	.....	54,326	.....

The prices for section 32 ranged as follows: Excavation and refill for 31 × 39-in. sewer., in tunnel, 850 lin. ft., $5.95 to $10 per lin. ft.; for 29 × 37-in. and 27 × 36-in. sewer, 2,240 lin. ft., $4.65 to $6.85; 25 × 34-in., 690 lin. ft., $4.14 to $7; 19 × 28-in., 1,300 ft., $3.65 to $5; brick masonry, American, in trench, 580 cu. yds., $12.35 to $14; in tunnel, 130 cu. yds., $15 to $16; brick masonry, Portland, in trench, 260 cu. yds., $14.45 to $16; in tunnel, $15.75 to $18; concrete masonry, American, in trench, 300 cu. yds., $5 to $6.50; Portland, in trench, 90 cu. yds., $7 to $8; Portland, in tunnel, 70 cu. yds., $9 to $10; spruce lumber, in place, 20 M. ft. B. M., $30 to $38.

Peoria, Ill.—Jacob A. Harman, Cy. Engr., informs us that the following bids were received May 8 for constructing the Spring St. sewer system:

Bids Received for Constructing Sewers, Peoria, Ill.

	R. J. Donnelley, Davenport, Ia.	W. J. Irwin, Greenville, O.	P. J. Shannahan, 1034 Adams St., Chicago.	Hallett & Anderson, Aurora, Ill.	Rockford Const'n Co., Rockford, Ill.	A. Magnus, 41 Milwaukee St., Elgin, Ill.	Anderson & Lindquist, 34 2d St., St. Paul.	Robert Clark, Peoria, Ill.	Roche & McNichols, 210 51st St., Chicago.	Dubuque Const'n Co., Dubuque, Ia.	Sheets & Moore, Uhrichsville, O.	Grimes & Moran, Elkhart, Ind.
Trenching, to 8 ft.	$0.28	$0.20	$0.40	$0.25	$0.30	$0.26	$0.18	$0.20	$0.30	$0.20	$0.24½	$0.55
" 8 to 10 ft.	.35	.25	.60	.40	.35	.29	.25	.25	.37	.24	.26	.55
" 10 " 12 "	.41	.50	.70	.50	.40	.40	.41	.04	.40	.38	.35½	.55
" 12 " 14 "	.55	.50	.85	.60	.50	.58	.45	.50	.54	.60	.41	.55
" 14 " 16 "	.66	.60	1.00	.70	.60	.70	.60	.60	.68	.60	.58	.55
" 16 " 18 "	.80	.70	1.15	1.20	.75	.85	.80	.70	.78	.88	.65	.55
" 18 " 20 "	1.18	1.20	1.35	2.50	1.00	1.00	1.25	.80	.96	1.05	.75	.55
" 20 " 24 "	1.68	....	1.60	3.20	1.50	1.25	2.00	.90	1.24	1.28	.85	.55
" 24 " 28 "	2.00	2.00	1.75	4.00	2.00	1.90	3.00	1.00	1.45	1.50	1.15	.55
18-in. pipe sewer.	.63	.40	.60	.95	.65	.48	.60	.60	.60½	.60	.68	.56
14-in. " " .	.39	.40	.50	.60	.40	.35	.45	.40	.43	.40	.56	.37
12-in. " " .	.33	.20	.40	.45	.30	.26	.34	.32	.36	.30	.36	.27
10-in. " " .	.27½	.15	.30	.40	.23	.20	.20	.25	.31	.23	.31	.22
8-in. " " .	.20	.10	.20	.25	.15	.15	.24	.17	.25	.18	.23	.14
4-in. drain tile	.05	.10	.10	.20	.03	.03½	.08	.04	.03½	.06	.06	.03
Galv. wrt. iron p'pe	.17	....	....	.35	....	....	....	.50	.20	....	.20	....
Manholes, 10 ft. dp.	31.46	35.00	33.00	40.00	35.00	40.00	34.00	35.00	32.00	30.00	29.00	34.00
Pr. extra ft. d'pth	1.25	2.00	2.00	1.00	2.50	3.00	2.50	3.50	2.00	1.75	1.05	1.75
Flush t'ks, 6" siph	35.00	50.00	38.00	40.00	40.00	53.00	30.00	35.00	35.00	35.00	29.00	48.00
" " 8" "	35.00	50.00	43.00	40.00	42.00	63.00	30.00	38.00	35.00	35.00	29.00	49.00
Emp. device, 6" "	28.00	25.00	33.00	30.00	25.00	38.00	30.00	30.00	33.00	45.00	28.50	26.00
" " 8" "	28.00	35.00	42.00	35.00	33.00	43.00	35.00	35.00	38.00	50.00	33.50	33.00
L'pholes, 10 ft. dp.	3.00	10.00	4.25	5.00	5.00	6.00	5.00	5.00	4.00	10.00	4.50	4.00
Pr extra ft. d'pth	.10	.30	.20	.20	.15	.50	.20	.20	.20	.50	1.05	.10
Extra excavation	.50	1.00	.50	.50	.50	.35	.30	.50	.50	.35	.40	....
Timber, M.ft., B.M.	20.00	25.00	25.00	25.00	25.00	30.00	20.00	20.00	25.00	20.00	24.00	20.00
Total amounts	$33,928	$30,213	$46,101	$45,265	$31,973	$32,628	$34,009	$30,187	$35,432	$31,737	$31,186	$35,139

ASPHALT PAVING.—Trenton, N. J.—The following bids were received for paving two streets with asphalt: New Jersey Paving & Construction Co., $2.56 per sq. yd.; Barber Asphalt Paving Co., $2.68 and $2.73; Geo. Acock, $2.87; Thos. Craig, $2.65 and $2.75.

Indianapolis, Ind.—The contract for paving the roadway of Wabash St., to a width of 20 ft., has been awarded to the Indiana Bermudez Asphalt Co., at $3.82 per lin. ft., for any curb except granite. The Warren-Scharf Asphalt Paving Co. bid $3.94 to $4.29 according to curb, and the Western Paving & Supply Co., $3.83 to $4.13.

Rochester, N. Y.—The following bids were received for paving Scio St. with asphalt, the first column being the price per sq. yd. for 2,680 sq. yds. of new pavement, the second column the price per lin. ft. for 1,500 lin. ft. of new cement sidewalk 5 ft. wide with grading 12 ft. wide, and the third column being the amount of bid:

Rock Asphalt Paving Co.	$2.60	$0.20	$8,057
Warren-Scharf Asphalt Paving Co.	2.40	0.40	8,178
Chambers & Casey	2.70	0.70	10,884
Rochester Vulcanite Pavement Co.	2.60	0.50	8,628

BRICK PAVING.—Davenport, Ia.—Thos Murray, Cy. Engr., writes us that contracts for paving in two streets and two alleys with brick have been awarded to McGugin & McRae, at 28 cts. per cu.yd. for excavation, $1.19 per sq. yd. for paving with a single course of Galesburg brick on 9 ins. macadam and 4 ins. sand, rolled with a 15-ton steam road roller; 5 cts. per lin. ft. for drain tile, 54 cts. for 20-in. Cleveland sandstone curbing or 64 cts. for 24-in. curbing; total, $15,285; Edwards & Walsh Construction Co. bid $1.23 to $1.36 for the paving, and Flick & Johnston, $1.29.

Houston, Tex.—G. M. La Noue, Cy. Engr., writes us that the following bids were received for paving a portion of Texas Ave. with vitrified brick upon a gravel foundation; the price in the second column being the price per cubic yard for excavation of earth roadbed:

R. C. Starrie, Fort Worth, Tex.	$2.10	$0.50
Jas. Brown, Houston	2.30	0.55
M. Hart, St. Louis, Mo.	2.45	0.60

Indianapolis, Ind.—The contract for paving Wabash St., 30 ft. wide, with brick on concrete has been awarded to Fulmer & Seibert, at $2.54 per lin. ft. on each side. The lowest bid for paving Meridian St., 60 ft. wide, was that of Harne & Hallwood, at $7.50 for Jones blue granite brick with any curb except granite and with pitch or grout filling.

Erie, Pa.—The contract for paving in Ninth St. has been awarded to V. D. Etchenlaub, at $1.60 per sq. yd., the property owners to be allowed 55 cts. per lin. ft. for curbing already set or contracted for. The other bids were as follows: Wm. A. Parke, $2.10; E. M. Ayres, Hallwood block, $1.77, or Jones block, $1.71; Henry Mayer, Mack shale, $1.83; Mack fine clay, $1.83; Metropolitan block, $1.83; blue granite, $1.76.

ARTESIAN WELLS.—Boone, Ia.—R. M. Mitchell, Cy. Engr., writes us that the contract for sinking an artesian well has been awarded to (2) J. P. Miller & Co., at $7,500, the other bids being (1) F. M. Gray, Milwaukee, $7,835, and (3) O. G. Wilson, Belleville, Ill., $6,425. The prices were as follows:

Bidder.	Sinking and casing, per ft. 18-in. hole, 350 ft.	12-in. hole, 150 ft.	6-in. hole, 600 ft.	6-in. hole, 600 ft.	6-in. hole, 500 ft.	Testing well with 10-in. pump, per hr.	Casing, per ft. 15-in.	12-in.	6-in.
1.	$6.45	$6.35	$2.80	$2.85	$3.60*	$1.00	$2.55	$1.68	$.48
2.	6.25	6.25	2.75	2.75	3.25*	1.00	2.65	1.75	.55
3.	4.50	4.00	3.00	3.00	2.50	1.00	..	..	..

* 50 cts. extra for each 200 ft. below 2,000 ft.

CEMENT.—Winchester, Mass.—Ernest W. Bowditch, Engr., Boston, informs us that the following bids were received May 9 for 450 bbls. Rosendale and 100 bbls. Portland cement: H. A. Emerson, Winchester, Rosendale, $1.20 for Hudson River brand and $1.25 for Brooklyn Bridge brand; Portland, $2.25 for Globe Portland and $2.40 for Offenbacher Portland; Waldo Bros., Boston, Rosendale, $1.08 for Rock Lock and $1.13 for Hoffman; Portland, $2.08 for for J. L. Spoor brand, $2.30 for Brooks Shoobridge, $2.70 for Olsen; Jas. A. Davis, $2.45 for Alpha brand of Portland; W. T. Bradley Co., Philadelphia, $2.18 for the W. T. B. brand of Portland.

SEWERS.—Athens, Ga.—J. W. Barnett, Cy. Engr., informs us that the contract for constructing the proposed sewers has been awarded to McPoland & Burkhalter, Birmingham, Ala., at $8,110. The bids were as follows:

Bids Received for Sewers at Athens, Ga.

Bidder.	Pipe sewers, including Y's. 18-in., 4,782 lin. ft.	12-in., 3,469 lin. ft.	8-in., 333 lin. ft.	—Earth excav. and back filling.— 3 to 4 ft., 2,340 lin. ft.	4 to 6 ft., 4,420 lin. ft.	6 to 8 ft., 2,440 lin. ft.	8 to 10 ft., 630 lin. ft.	10 to 12 ft., 1,150 lin. ft.	12 to 14 ft., 460 lin. ft.	14 to 16 ft., 130 lin. ft.	16 to 18 ft., 200 lin. ft.	Rock excav. in Hard, per lin. ft. per ft. in depth, 3,900 lin. ft.	Soft, per lin. ft. per ft. in depth, 1,830 lin. ft.	Manholes, 29.	Lampholes, 3.	Flush tanks, 3.	I. pipe f'd with lead j'nts, 1.4 C'ns.	Rock work, 1.4 cu. yds.	Rubble masonry, 3.3 cu. yds.	Embankment, 53 cu. yds.	Total.
McPoland & Buckhalter, Birmingham, Ala.	$.45	$.25	$.18	$.18	$.19	$.20	$.23	$.26	$.28	$.32	$.36	$.14	$.10	$35.00	$35	$39	$25	1¼	3½	$.30	$8,110
J. A. L. Minor & Co., Birmingham, Ala.	.66	.43	.31	.10	.14½	.21	.31	.42	.62½	.68	.77	.24	.12	24.78	1	61	30	9½	8	.25	10,392
D. Lee Wardroper & Co., Gainesville, Ga.	.41	.29	.18	.09	.12	.18	.24	.33	.30	.48	.55	.35	.15	28.00	1½	70	30	20	23	.75	8,457
Lambert & Lyell, Atlanta, Ga.	.53	.34	.23	.11	.17	.22	.28	.43	.50	.67	.76	.31	.10	30.00	30	30	45	18	40	.15	9.801
J. J. Anthony, Chattanooga, Tenn.	.53	.34	.23	.11	.18	.26	.37	.54	.66	1.10	1.55	.55	.28	44.00	4	88	55	12	7	.45	12,193
Gabourg & Noble, Macon, Ga.	.59	.30	.18	.09	.11	.15	.25	.34	.44	.55	.68	.29	.17	23.00	4	49	30	40	59½	.20	9,034
M. B. McGinty, Athens, Ga.	.58	.30	.17	.11	.14	.18	.25	.30	.36	.42	.47	.45	.20	30.00	3½	65	30	18	5	.20	9,783

CAST IRON FOOT BRIDGE.—Allentown, Pa.—A contract for a cast iron foot bridge has been awarded to the Donaldson Iron Co., at 1¾ cts. per lb.

SEWER BRICK.—Winchester, Mass.—Bids for 200,000 sewer brick ranged from $7.87½ to $10.50 per M. Engr., Ernest W. Bowditch, Boston.

CEDAR BLOCKS.—Milwaukee, Wis.—A contract for 6,500 sq. yds. of 8-in cedar paving blocks has been awarded to M. J. Rice, at 52 cts. per sq. yd.

METAL MARKET PRICES.

LEAD.— New York: 3.3 to 3.33 cts. Chicago: 3.25 cts. St. Louis: 3.15 to 3.2 cts.

NAILS.—Pittsburg: $1.05 for wire, and 95 cts. to $1 for cut at mill.

FOUNDRY AND PIG IRON.—New York: $10.50 to $13.25. Pittsburg: $9.75 to $11.25. Chicago: $10 to $11.50.

TRACK MATERIAL.—New York: angle bars, 1.25 to 1.4 cts.; spikes, 1.55 to 1.7 cts.; track bolts 2 to 2.1 cts. with square and 2.15 to 2.3 cts. with hexagon nuts. Chicago: angle bars, 1.35 to 1.4 cts.; spikes 1.6 to 1.7 cts.; track bolts, 2.2 to 2.3 cts., with hexagon nuts.

RAILS.—New York: $24 to $25 at eastern mills and at tidewater; old rails, $11 for iron, and $9 for steel; light rails, $22 to $24; girder rails, $21 to $24. Pittsburg: $24 for standard sections. Chicago: $25 to $27; old rails, $10 for iron and $9.50 to $10 for steel.

STRUCTURAL MATERIAL.—New York: beams, 1.3 to 1.5 cts.; channels, 1.3 to 1.5 cts.; angles, 1.2 to 1.35 cts.; tees, 1.4 to 1.6 cts.; universal mill plates, 1.15 to 1.35 cts.; steel plates, 1.2 to 1.3 cts. for tank, 1.35 to 1.4 cts. for shell, 1.55 to 1.6 cts. for flange, 1.75 to 2 cts. for ordinary firebox, 2 to 2.25 cts. for locomotive firebox. Pittsburg: beams, 1.25 to 1.3 cts.; channels, 1.25 to 1.3 cts.; angles, 1.15 to 1.2 cts.; tees, 1.25 to 1.35 cts.; universal mill plates, 1.15 to 1.2 cts.; steel plates, 1.2 to 1.3 cts. for tank, 1.4 cts. for shell, 1.4 to 1.5 cts. for flange, 1.75 to 4 cts. for firebox. Chicago: beams, 1.45 cts.; channels, 1.45 cts.; angles, 1.4 cts.; tees, 1.6 cts.; universal plates, 1.4 cts.; steel plates, 1.4 to 1.5 cts. for tank, 1.5 to 1.6 cts. for shell, 2.1 cts. for flange, 2.5 to 5 cts. for firebox.

INDUSTRIAL NOTES.

THE INDIANA BERMUDEZ ASPHALT CO., which has contracts for asphalt paving at Indianapolis, will erect a plant near that city.

THE WORTHINGTON PUMP CO.'S works at Elizabethport, N. J., were partly destroyed by fire May 16, involving a loss of about $100,000.

ROLLING STOCK.—The Gulf, Beaumont & Kansas City Ry. will purchase a locomotive and three passenger cars. Vice-Pres., J. H. Kirby, Beaumont, Tex.

THE PULLMAN PALACE CAR CO., of Chicago, Ill., has a contract for 1,000 cars for the Baltimore & Ohio Southwestern Ry.

THE NORDBERG MFG. CO., of Milwaukee, Wis., has the contract for triple expansion pumping engines of 5,000,000 gallons daily capacity for Washington, D. C., and New Castle, Pa., and two pumping engines of 1,500,000 gallons capacity for Winchester, Va.

THE F. O. NORTON CEMENT CO., New York, is issuing views of various buildings in which its cement is used, and is prepared to have photographs made at its own expense and several thousand pictures by photogravure process issued of such buildings.

L. K. HIRSCH, 549, Rookery Building, Chicago, is to wreck the movable sidewalk at the Columbian Exposition, recently purchased by him (Eng. News, April 26, 1894), and will change the 351 cars into dump, coal and mining cars for contracting and general use. He will also sell the 30-lb. rails and the sheds, etc.

THE LONE STAR IRON WORKS, of Jefferson, Tex., will be sold by auction June 5. The plant includes a 60-ton 12 × 70-ft. blast furnace, a rolling mill, engines, rolls, boilers, tools, buildings, real estate and stock of ore, pig iron, etc. The upset price is $65,000. For particulars address J. M. Deware and T. D. Rowell, commissioners, Jefferson, Tex.

THE WESTERN FILTER CO., 312 North Fourth St., St. Louis, Mo., has been awarded contracts for putting in filtering plants for the new union station and the new Planter's Hotel, St. Louis; also for the Wolf Bros. Laundry Co., Kansas City, Mo., and is now engaged in putting in plants for the water-works at Pontiac, Ill.; Chester, Ill., and Columbia, Mo.

THE RENSSELAER MFG. CO., through its special representative, Octavous Jones, Monadnock Block, Chicago, has recently secured contracts for its straightway valves for the following water-works: Cleveland, O.; Monongahela Water Co., Pittsburg, Pa.; Glencoe, Ill.; Marcellus, Mich.; also valve boxes, Para, Ill.; Altoona, Pa., and a carload to the Cicero, Ill., works. This company is now manufacturing valve boxes.

THE SCOVILLE IRON WORKS, Chicago, have been awarded a contract for furnishing a complete mining plant to the Cripple Creek Mining Co., Cripple Creek, Colo., including engines, boilers, pulverizers, crushers, tools, etc. They also have a contract from Johnson Bros., Chicago, for another complete contractors' plant for use on the drainage canal. Pres. & Supt., H. H. Scoville; Secy. and Treas., F. B. Macomber.

NEW COMPANIES.—Comfortable Sleeping Car Co., Chicago, Ill.; $300,000; Gottlieb Kern, G. Fleischmann and Carl Warora.——Buckatauba River Improvement Co., Eagle River, Wis.; $6,000; John Joyce, John Hansen, and J. D. Hoogstraat.——Converse Bridge Co., Chattanooga, Tenn.; W. H. Converse, Francis Morton and T. A. Evans.——Peoria Automatic Filter Co., Peoria, Ill.; $50,000; Delos C. Brown, A. F. Johnson and G. S. Geiger.——Lyman Windmill & Power Co., Chicago, Ill.; $50,000; H. C. Lyman, Jas. Heckman and C. C. Carnanan.——South Amboy Gas Light Co., South Amboy, N. J.; $30,000; F. D. Safford, G. H. Frey, and Adolphus Brown.——Germantown Steam Co., Philadelphia, Pa.; $30,000; heat and power; Treas., W. R. Smith, Overbrook, Pa.